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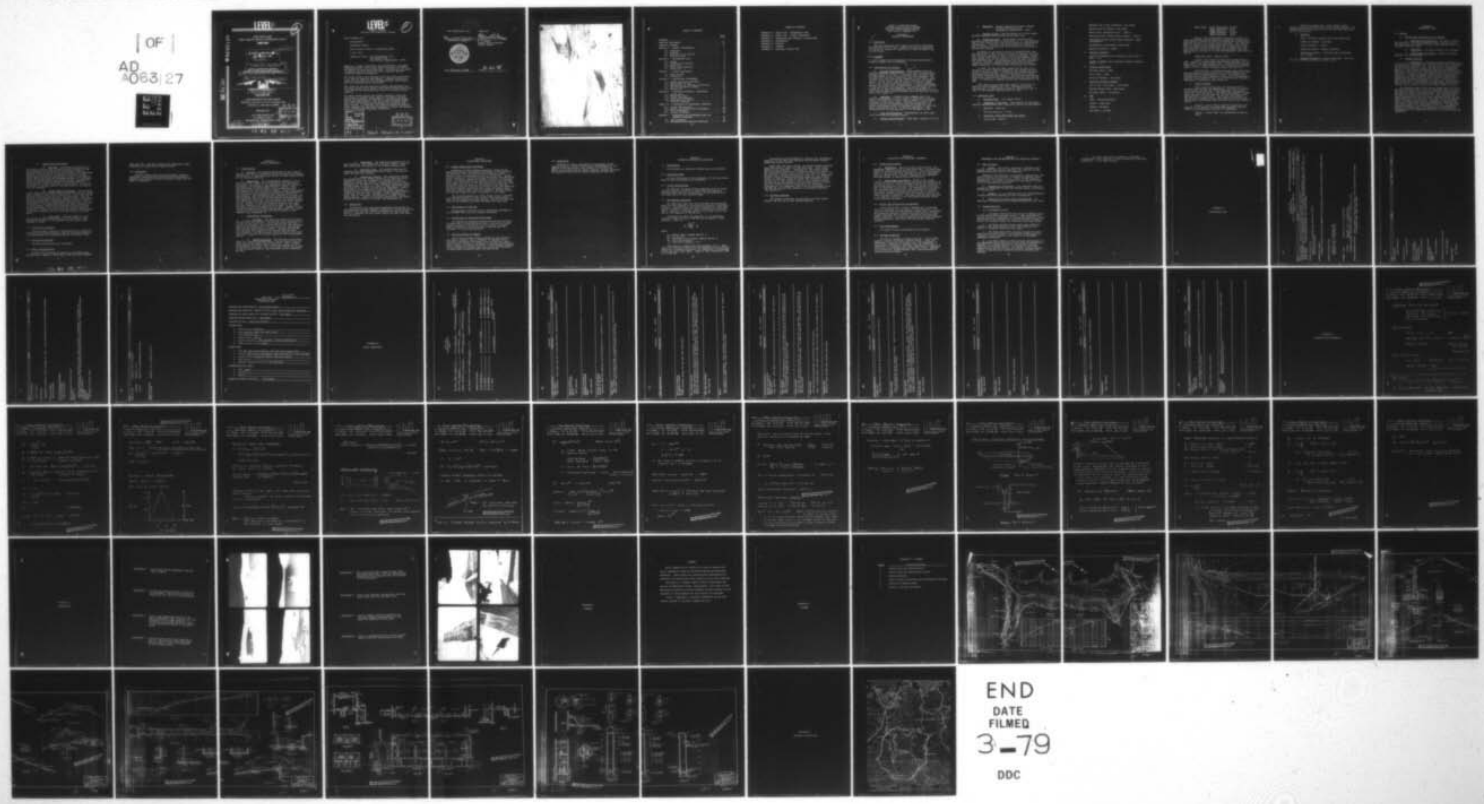

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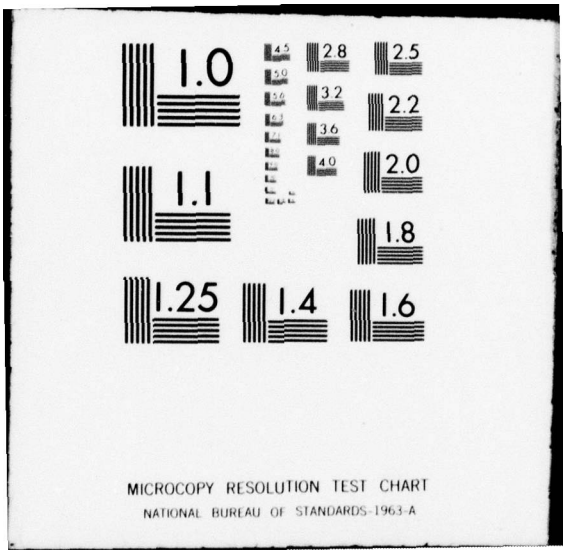
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LEVEL II

OHIO RIVER BASIN
POINT LOOKOUT BRANCH, WASHINGTON COUNTY
PENNSYLVANIA

WATER COMPANY DAM 4,
NDI NO. Pa—507.

Ohio River Basin, Point Lookout Branch,
Washington County, Pennsylvania.

PHASE I INSPECTION REPORT,
NATIONAL DAM INSPECTION PROGRAM.

(15) DACW31-78-C-0052

(10) Bernard M. Mihalcin

PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

(12) 77p.

(11) JULY 1978

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LEVEL II

PHASE I REPORT
National Dam Inspection Program

Water Company #4

Pennsylvania

Washington County

Point Lookout Branch of Chartiers Creek

2 June 1978

Inspection Team - GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

Based on a visual inspection, past performance, available engineering data, and a brief design analysis, the dam is considered to be in good condition. The spillway is capable of passing the flow resulting from a storm of the PMF intensity without overtopping.

The lower third of the spillway chute has deteriorated and is in need of remedial maintenance. Seepage through and under the spillway near the embankment bench level should also be investigated and controlled.

The riprap on the upstream face appears underdesigned and the owner should place larger, more durable materials on the slope within the operating pool levels to prevent further erosion.

The owner should revise the present emergency plans for maintaining a potable water supply to include a warning system for downstream residences in case emergency embankment conditions develop. The plans should include round-the-clock surveillance during periods of unusually high water levels. In addition, the facility should be periodically inspected by qualified personnel to detect the development of potentially hazardous conditions.

Contract DACW31-78-C-0052

GAI Consultants, Inc.

Bernard M. Mihalcin

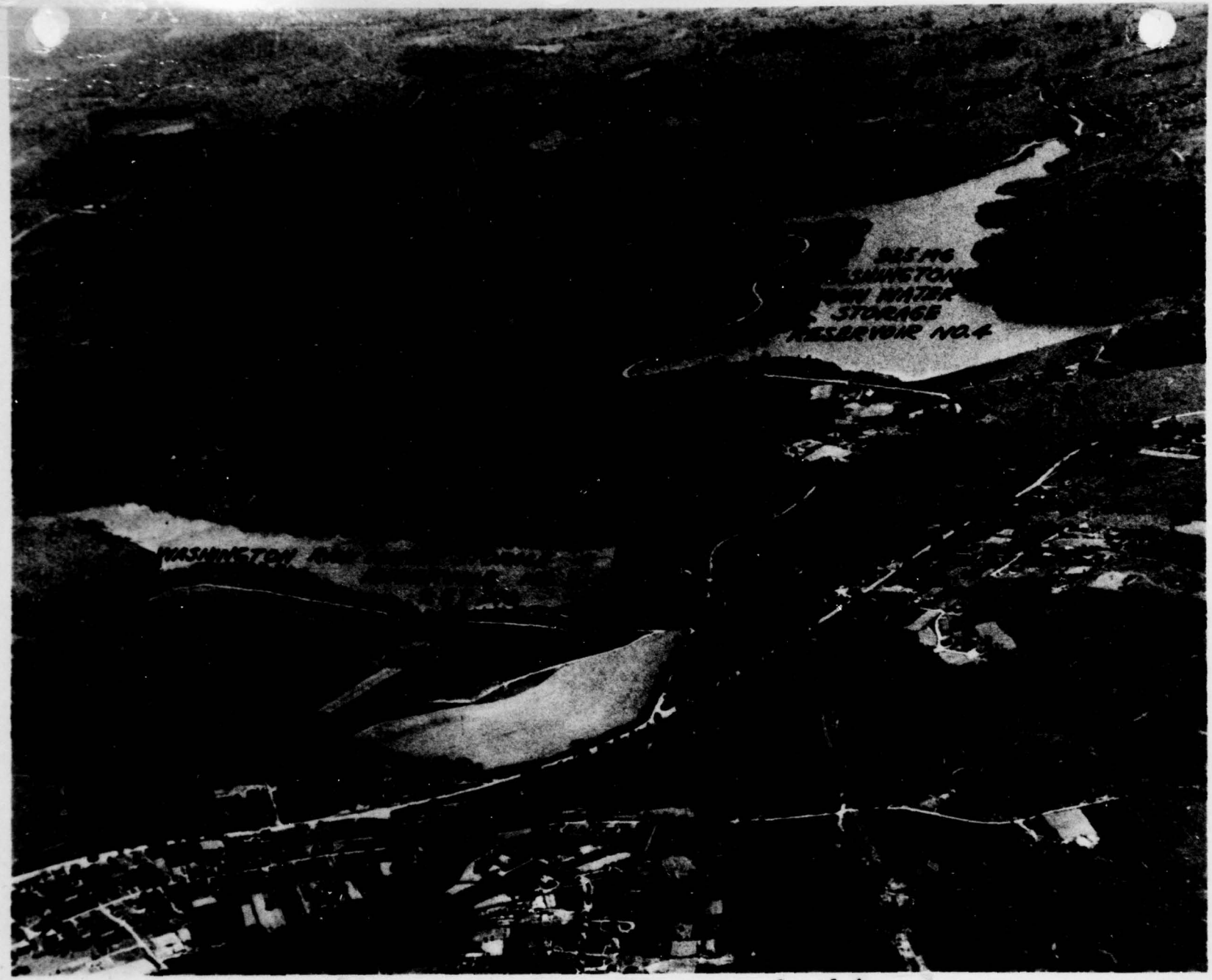
Bernard M. Mihalcin

Date July 21, 1978

Approved:

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date 31 Jul 78



Overview Photograph of Dams nos. 3 and 4 iii

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TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
CITIZEN'S WATER COMPANY DAM #4
NDI# PA-507, PENNDER# 63-3

SECTION 1
GENERAL INFORMATION

ABSTRACT

1.0 Authority.

The Dam Inspection Act, Public Law 92-367 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

ABSTRACT

1.2 Description of Project.

a. Dam and Appurtenances. Water Company #4 is an earthen embankment approximately 1,260 feet in length with a maximum height of 63 feet. A concrete chute spillway with an ogee-shaped crest is located at the left abutment. Two 24-inch cast iron pipes which originate at the intake tower located to the left of the dam center comprise the outlet works. One of these conduits serves as a gravity supply line to the filter plant approximately 1.5 miles downstream whereas the second line is connected to a pump house located at the toe of the left abutment. The latter conduit is valved as it enters the pump house and is connected to a 16-inch blow-off pipe which discharges into the spillway stilling basin (see Figure 2).

b. Location. Citizen's Water Company Dam #4 is located approximately 2 miles south of Washington, Pennsylvania, off Route 18, on Point Lookout Branch, a first order tributary of Chartiers Creek. The dam and reservoir are contained within the Washington West and Prosperity 7.5 minute quadrangles while the watershed extends into both the Amity and Washington East 7.5 minute quadrangles. The coordinates of the dam are N40° 8' 30" and W80° 15' 50".

c. Size Classification. Intermediate (63 feet high, 2,837 acre-feet at spillway crest).

d. Hazard Classification. High (Ref: Section 3.1.c.5).

e. Ownership. Western Pennsylvania Water Company.
62 East Wheeling Street
Washington, Pennsylvania 15301

f. Purpose of Dam. The dam serves as a water supply storage reservoir with limited recreational use.

g. Historical Data. The original structure was designed by William Wylie of Washington, D. C., and constructed in 1901-1903 by Latta and Terry Company of Philadelphia, Pennsylvania. Initially, the structure was 45 feet high with a reservoir surface area of 70 acres and a capacity of 600 million gallons.

According to available records in PennDER files, the dam was raised 3 feet in 1923 in order to increase the overall reservoir capacity by about 75 million gallons. Reportedly, steps were taken at this time to curb seepage at the left abutment and at the spillway, which was then located on the right abutment. These problems were noted in detailed inspection reports submitted years earlier by the Water Supply Commission of Pennsylvania (precedessor of PennDER).

In 1935, the dam was again raised (by 15 feet) to a height of 63 feet, thereby increasing the storage capacity to 92.5 million gallons. Included in this renovation was a grouting program as well as the installation of a cutoff wall which extended into bedrock. The original spillway was filled and a new spillway constructed along the left embankment. In addition, a pumping station was constructed at the toe.

More recent state inspection reports, the latest of which is dated September 25, 1961, indicated that the facility was in good overall condition, exhibiting few, if any, of the problems reported prior to 1935.

1.3 Pertinent Data.

a. Drainage Area. 2.25 square miles.

b. Discharge at Dam Site. The capacity of the outlet works at maximum pool level (elevation 1103.6) are as follows:

Spillway - 3924 cfs.

16-inch blow-off - 63 cfs.

c. Elevation (feet above mean sea level).

Top of Dam - 1103.6.

Maximum Pool Design Surcharge - Not known.

Maximum Pool of Record - Not known.

Normal Pool (spillway crest) - 1096.6.

Upstream Portal Invert Outlet Conduit - 1081.6.

Downstream Portal Invert Outlet Conduit - 1038 (estimated).

Streambed at Centerline of Dam ≈1035.

Maximum Tailwater - 1038.

d. Reservoir (miles).

Length of Maximum Pool (elevation 1103.6 top of dam) ≈ 1.4.

Length of Normal Pool (elevation 1096.6 spillway crest) ≈ 1.1.

e. Storage (acre-feet).

Spillway Crest - 2837.

Top of Dam ≈ 3528.

Design Surcharge - Not known.

f. Reservoir Surface (acres).

Top of Dam - Not known. ≈140 acres.

Maximum Design Pool - Not known.

Spillway Crest - 125 acres.

g. Dam.

Type - Rolled earthfill.

Length - 1260 feet.

Height - 63 feet.

Top Width - 18 feet.

Side Slopes - Lower Downstream 2.5H:1V
Upper Downstream 2H:1V
Lower Upstream 3H:1V
Middle Upstream 2.5H:1V
Upper Upstream 2H:1V

Zoning - Earth embankment reportedly rolled in 6-inch layers consisting of impervious materials between the upstream face and the central core increasing in permeability from the central core to the downstream face. The upstream face is covered with crushed stone and/or slag and a rock-fill was placed at the downstream toe. Drawings also indicate drainage laterals at 75-foot centers extend from the downstream toe to the toe of the old embankment (see Figures 2 and 3).

Impervious Core - Rolled earth.

Cutoff - Two cutoff trenches were constructed in 1935. Both are located along the original spillway, one on each side of the ogee-shaped crest. The downstream channel cutoff trench is approximately 14 feet wide and is equipped with a (1.2 x 3.0 feet) concrete cutoff (see Figure 3).

Grout Curtain - Drawings indicate that grout holes were drilled along both the left and right abutments to an average depth of approximately 40 feet. The best record available on the grout program is detailed on construction drawings dated August 1935 by the Citizen's Water Company of Washington, Pennsylvania (see Figure 3).

h. Outlet Conduit.

Type - Two 24-inch cast iron pipes encased in concrete pass through the embankment. One line is reduced to 16 inches near the toe of the embankment and gravity feeds the filtration plant. The other line enters the pump house and has a 16-inch blow-off tap that discharges into the spillway stilling basin. The latter line actually functions as a supply line to the reservoir from the pump system which draws water from Chartiers Creek (see Figures 2 and 6).

Closure - Gate valves, manually controlled, are located in two towers, one inside the reservoir and the other on the downstream slope of the embankment.

Access - Intake tower is inaccessible except by boat.

Regulating Facilities - Flow through outlet conduits can be regulated at the intake towers, however, the normal procedure is to regulate flow at the pump house and the filtration plant.

i. Spillway.

Type - Concrete channel with ogee-crested weir.

Length of Channel ≈ 360 feet.

Crest Elevation - 1096.6.

Upstream Channel - Natural approach.

Downstream Channel - Stilling basin discharges into stream.

j. Regulating Outlets. None in spillway. Low flow can be controlled through a blow-off line.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. No design reports are available. A storage capacity versus elevation curve and weekly storage capacity records (1960 through 1978) were available from the owner.

2. Embankment. No design reports are available.

3. Appurtenant Structures. Structural design analyses are not available.

b. Design Features.

1. Embankment. Available contract documents and historical data indicate that the present facility, designated as Washington (reservoir) No. 4 by the owner, was constructed of rolled earthfill with a central core of impervious material. The original embankment which was constructed in 1903 was incorporated into the present structure and currently functions as a part of the upstream portion of the dam (see Figure 3). Contract drawings indicate that grouting was performed near both abutments above elevation 1060 when the present facility was constructed in 1936. A total of 59 holes were drilled and grouted to depths that varied from 16 feet to 69 feet. No holes were drilled within the 500-foot section below elevation 1060 at the dam's center section.

The upstream slope of the dam at normal pool is 2.5H on 1V and increases to 3H on 1V as it descends toward the toe. The slope is faced with a well graded slag (6-inch apparent maximum) and possibly crushed stone. The downstream face of the structure has a slope of 2H to 1V near the dam crest which increases to 2.5H to 1V as it descends toward the toe. Approximately 25 feet from the dam crest, on the downstream side, is a berm 3.5 feet wide. A gutter along this berm carries surface runoff from the embankment. Drawings indicate that a stone fill was placed at the toe. In addition, drainage trenches 1 foot wide by 2 feet deep composed of gravel and broken stone are indicated on 75-foot centers extending from the downstream rock toe to the toe of the old embankment.

2. Appurtenant Structures.

a) Spillway. The primary discharge is a reinforced concrete ogee spillway located adjacent to the left abutment (see Figure 4 and Photographs 5 and 6). Drawings indicate the spillway slab is keyed into impervious material at the entrance as shown on Figure 4. French drains extend along the outside base of both wing walls to divert water away from the spillway footings. In addition, there are drains beneath the spillway slabs, the main collector of which emerges through the concrete chute at approximately 50 feet above the stilling basin. The stilling basin is located adjacent the pump house at the base of the left abutment.

b) Intake Tower and Outlets. Two low level outlet conduits are valved within a circular concrete intake tower located off the left of dam center. The valves can be manually operated from the top of the structure. Two 24-inch cast iron pipes enclosed in concrete lines run parallel beneath the embankment through a second gate house in the downstream slope until they separate near the toe. One line is directed to the pump house while the other reduces to a 16-inch diameter conduit which carries flow to the filter plant downstream. The line leading to the pump house is valved just outside of it and is fitted with a 16-inch blow-off which discharges directly into the spillway stilling basin.

c) Pump House. The pump house is a one-story masonry structure located at the left base of the embankment adjacent to the spillway stilling basin (see Figures 2 and 5).

2.2 Construction Records.

Data available relative to construction are limited to construction drawings obtained from the owner and construction photographs and drawings contained in PennDER files.

2.3 Operational Records.

No operational records are available.

2.4 Other Investigations.

Several state inspection reports are available from PennDER files, however, the majority span the years between

1920 and 1946. The most recent state inspection report contained in these files is dated 9-25-61.

2.5 Evaluation.

Specific design data are not available, however, sufficient information was available from construction drawings and historical files to provide a basis for the Phase I evaluation.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of this project suggests the dam and appurtenances are adequately maintained, and presently in good condition except for some deterioration of the concrete spillway.

b. Embankment. The dam embankment appears to be in good condition. There is no evidence of any cracking or sloughing. Settlement of the embankment crest was found to be minimal not exceeding approximately 4 inches. The upstream slope is covered with a well graded slag with maximum particle size of about 6 inches. Minor slope erosion was evident in a few areas on the upstream slope indicating that the protection provided by this riprap material is questionable. The downstream slope contains a 3.5-feet wide bench drained with a stone gutter located approximately 25 feet below the dam crest. No indications of seepage through the embankment slope were observed during the field investigation. However, a seep was observed adjacent the right spillway wingwall with flow emanating about 10 feet below the bench (visually estimated to be 5 gpm). Leakage is also visible through the spillway slab slightly above this level indicating the source of the seep may originate in the abutment (see Photograph 7).

c. Appurtenant Structures.

1. Spillway. The upper two-thirds of the spillway including the wingwalls and channel floor appeared to be in fair to good condition. Joints and popouts have been sealed with bitumen. The bottom third of the spillway chute above the stilling basin is in poor condition with random spalling and severe scaling evident. Leakage through the left spillway wall appears to be causing some concrete deterioration. The ogee portion of the spillway and plunge pool walls appear to be in good condition (see Photographs 5 and 6).

2. Intake Structure. The upstream intake structure is a circular concrete tower, the top several feet of which are visible above normal pool level. Some concrete deterioration is evident but it generally appears to be in satisfactory condition. Four valve stems can be seen on top of the structure, however, the structure is not accessible by foot.

3. Pump House. The pump house appears to be in good condition. The mechanical equipment housed inside is well maintained and appears to be in good working order.

4. Reservoir Area. The slopes adjoining the reservoir area are heavily wooded and steep. No signs of slope distress were evident.

5. Downstream Channel. The downstream channel is a relatively flat, broad floodplain of Chartiers Creek. Vegetation within the floodplain is sparse consisting chiefly of shrubs and grasses. Approximately 2,000 feet downstream of the dam is a small community containing about 20 homes along PA Route 18. Many of these dwellings would be affected by a sudden failure of the embankment. Other dwellings in the community of Franklin Farms are also located within the Chartiers Creek floodplain approximately 6,000 feet from the dam. However, as the floodplain is quite wide in this area, the effects of a sudden breach appear minimal. Based on the above observation, the hazard rating for the facility is "high" (see Photograph 8).

3.2 Evaluation.

A relatively well maintained embankment and access to the pump house enabled adequate inspection of these facilities. Access to and into the intake structures was not available and it is assumed that the valves (which are kept full open) are functional.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operational Procedure.

According to water company personnel, there are no established regular operational procedures at the facility. The reservoir level is maintained at elevation 1096.6 leaving 7 feet of freeboard to the top of the dam. Excess inflow passes over the spillway and discharges into Chartiers Creek. The water company has dammed a portion of Chartiers Creek just downstream of the pump house with large boulders. This causes the water in the stilling basin to back up, thus, providing a pond of water at the bottom of the spillway. During periods when the pool level drops within the reservoir, the water company replenishes the supply by pumping water from the stilling basin into the reservoir, thereby keeping the storage volume as large as possible at all times.

The 16-inch diameter low level supply line is operated on a continual basis in order to meet the potable water needs of the communities being served. The 16-inch blow-off line can be operated only when the pumps are shut down.

4.2 Maintenance of the Dam.

Maintenance at the facility is reportedly provided on an as-needed basis by water company personnel.

4.3 Maintenance of Operating Facilities.

All mechanical equipment associated with the facility is reportedly in good operating order. According to water company personnel, the facility is visited on a regular basis to assess its condition and to confirm that all equipment is functioning properly.

4.4 Warning Systems in Effect.

There are no formal warning systems at the facility. The owners, however, have a document in proposal form entitled, "Emergency Contingency Plan to Maintain a Safe Potable Water Delivery to Consumers of Western Pennsylvania Water Company, Washington District." This document could be readily adapted to include dam surveillance and evacuation of downstream residences should the need arise.

4.5 Evaluation.

Although no formal procedures are available, water company personnel appear sufficiently knowledgeable in the operation and maintenance requirements of the facility. There is no formal warning system, however, company documents are available which can be readily adapted for this use.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No hydrologic or hydraulic design data are available.

5.2 Experience Data.

No data pertaining to the evaluation of spillway design based on past performance are available.

5.3 Visual Observations.

The dam and its appurtenances appeared to be in satisfactory condition relative to hydrologic and hydraulic considerations with the exception of the deterioration of the lower third of the spillway chute.

5.4 Overtopping Potential.

The "PMF Peak Flow" for this watershed was determined based on data supplied by the Corps of Engineers, Baltimore District. Specifically, the data pertains to a stream gage station located on Chartiers Creek at Washington, Pennsylvania. Based on a drainage area of 28.6 square miles, the PMF at this location is 27,200 cfs.

Utilizing this data and applying it, the following equation yields a value of PMF for the watershed in this analysis. That is:

$$Q_1 = \left[\frac{D_1}{D_2}\right]^n Q_2$$

where

Q_1 = PMF at Water Company Dam No. 4
Q_2 = 27,200 cfs
D_1 = drainage area of Water Company Dam No. 4
D_2 = 28.6 square miles.
n = empirical constant = 0.7.

The value of n chosen for this analysis is 0.7. This value falls between those values recommended by the Corps of Engineers, Pittsburgh District, for comparison of watersheds within the Ohio River Basin. Based on this information, PMF Q = 4,588 cfs.

Calculations were performed to evaluate the overtopping potential of the dam using spillway and available storage capacities during the PMF.

Based upon the above values, the inflow volume resulting from this storm is equal to 6,446 acre-feet. This figure appears to be excessive. Consequently, the inflow volume was recalculated based on an average rainoff of 26 inches. The resulting inflow volume is equal to 3,120 acre-feet. The spillway has a maximum discharge of 3,924 cfs. A comparison of peak inflow to maximum discharge shows the some storage volume is required. Based on normal pool elevation 1096.6 and the top of dam elevation 1103.6, the available storage is found to be approximately 690 acre-feet which is greater than the volume of storage required of 437 acre-feet. Consequently, the embankment would not be overtopped during the PMF and the spillway capacity is considered adequate (see Appendix C).

5.5 Spillway Adequacy.

The analysis indicates the spillway will pass and/or contain the PMF and is thus deemed adequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appeared to be in good condition. The embankment showed no signs of maintenance neglect. Aside from the seep noted at the spillway wall, seepage through the embankment does not appear to be a problem indicating the embankment drainage system is functioning satisfactorily.

b. Appurtenant Structures. Based on the visual inspection, the pump house and intake structure appear to be in good condition. The noticeable concrete deterioration on the intake structure does not affect its proper operation and is considered to be minor. The appearance of the spillway indicates maintenance has been performed in the past. Its general condition appears sufficient for its proper operation, however, the need for some remedial work to the lower portion is apparent. The flow along the spillway wall is an apparent failure of the underground drainage system associated with spillway.

6.2 Design and Construction Techniques.

Actual design data, design computations, or reports were not available for any aspect of this facility. Construction drawings and photographs coupled with a hydrologic and hydraulic analysis indicate that the facility is adequately designed and in general accordance with accepted modern practices. An area of concern is the rather informal zoning required by the design and the minimal internal drainage.

6.3 Past Performance.

No records of past performance are available.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and is thus subject to minor earthquake induced forces. Since the embankment slopes are relatively flat, the embankment is broad based, composed of residual clay-like soils and apparently well drained, the static stability is considered sufficient to withstand minor earthquake forces. However, no calculations, investigations, etc., were performed to confirm this conclusion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, available engineering data, and analysis suggests this facility is adequately maintained and in good condition.

Hydraulic and hydrologic calculations prepared for this report indicate the spillway is capable of passing and/or storing the flow resulting from a storm of PMF intensity. Consequently, an overall assessment of the project is that it is in satisfactory condition.

b. Adequacy of Information. The available data are considered sufficient to make an adequate Phase I assessment of the facility.

c. Urgency. It is suggested that the recommendations listed below be implemented as soon as practical.

d. Necessity for Additional Investigations. No additional investigations are deemed necessary at this time.

7.2 Recommendations.

It is recommended that:

a. the owner investigate and initiate remedial repair of the deteriorated spillway section. The investigation should include an assessment of the seepage source(s) within and adjacent the spillway with possible remedial schemes to direct the seepage through the underlying drainage system.

b. the owner provide larger sized, more effective riprap to the upstream slope within the operating pool levels to eliminate erosion of the slope.

c. the owner adapt their proposed emergency contingency plan for maintaining a safe potable water supply to include a warning system in the event of an emergency embankment condition.

d. the owner provide round-the-clock surveillance of the embankment during periods of high water to determine if seepage is a problem considering the minimal internal drainage and informal zoning. If seepage or wet areas appear during periods of high pool levels, further studies should be initiated and measures taken to alleviate the problem.

e. the owner institute a procedure of periodic inspections of the facility to detect potentially hazardous conditions as or as they develop.

APPENDIX A

ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Citizen's Water Co. Dam #4

ID # NDI PA-507, PennDER 63-3

ITEM	REMARKS	SHEET 1

AS-BUILT DRAWINGS (None of the following are marked "as built")
(from PennDER) Set of 15 drawings dated 4-20-35 by Supervising Engineers, Inc., of N.Y.C.
(from Owner) Set of 6 drawings dated 1936 (revised) by Supervising Engineers, Inc., of N.Y.C.
(from Owner) 5 miscellaneous drawings with various dates

REGIONAL VICINITY MAP

Drawing 1 of 5 (revised set, dated 11-12-35).
Aerial Photograph.

CONSTRUCTION HISTORY

A partial history has been composed by GAI based on information contained in PennDER files.

TYPICAL SECTIONS OF DAM

Drawing 2 of 5 (revised set)
Drawing 3 of 5 (revised set)

OUTLETS - PLAN Drawing 2 of 5 (revised set)

- DETAILS Drawing 3 of 5 (revised set)
  Drawing 6 of 6 (dated 4-30-35)
- DISCHARGE RATINGS Spillway capacity vs elevation curve

RAINFALL/RESERVOIR RECORDS Weekly reservoir capacity records (1960 through 1978) available on standard graph paper from owner.

DESIGN REPORTS

None available.

GEOLOGY REPORTS

None available.

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES

None available.

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

None available.

POST-CONSTRUCTION SURVEYS OF DAM

None available.

BORROW SOURCES

Not known.

ITEM	REMARKS	ID # PA-507	SHEET 3

MONITORING SYSTEMS

None on site.

MODIFICATIONS

Embankment raised in 1923 and again in 1935. Other modifications are detailed on drawings.

HIGH POOL RECORDS

None available.

POST CONSTRUCTION ENGINEERING
STUDIES AND REPORTS

None available.

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS

Reports compiled by Pennsylvania Water Supply Commission (predecessor of PennDER) are available in PennDER files and described problems both major and minor, developed throughout the dams history.

MAINTENANCE
OPERATION
RECORDS

Available at filter plant.

ITEM	REMARKS	ID # PA-507	SHEET 4
SPILLWAY PLAN	Drawing 2 of 5 (revised)		
SECTIONS	Drawing 4 of 5		
DETAILS	Details on miscellaneous drawings		
OPERATING EQUIPMENT PLANS & DETAILS	Drawing 5 of 5 (dated 4-20-35)		

NDI PA-507

CHECK LIST ID # PennDER 63-3

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 2.25 square miles.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): ele. 1096.6 (925 mil. gal:est)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not known.

ELEVATION MAXIMUM DESIGN POOL: Not known.

ELEVATION TOP DAM: elevation 1103.85.

SPILLWAY DATA:

a. Crest Elevation 1103.85
b. Type Concrete chute with ogee crest.
c. Weir Length 56.5 ft.
d. Channel Length 360 ft.
e. Location Spillover Left abutment (looking downstream)
f. Number and Type of Gates None.

OUTLET WORKS:

a. Type 16" cast iron blow-off, 16" cast iron supply line.
b. Location Left side of embankment approximately 400' from spillway.
c. Entrance Inverts Elevation 1081.6 (for both pipes).
d. Exit Inverts
e. Emergency Draindown Facilities 16" blow-off.

HYDROMETEOROLOGICAL GAGES:

a. Type None.
b. Location -
c. Records -

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX B

VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

DAM NAME Water Company # 4 COUNTY Washington STATE Pennsylvania ID # NDI# PA-507 PennDER 63-3

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(S) INSPECTION 2 June 78 WEATHER sunny & hot TEMPERATURE 75°-85°

POOL ELEVATION AT TIME OF INSPECTION 1096.3 M.S.L. TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL:

B. M. Mihalcin
J. P. Nairn
K. H. Khilji
D. L. Bonk

L. Busack - PennDER
B. M. Mihalcin RECORDER

R. Newman - W.P.W.
J. Orlando - W.P.W.
W. McAdams - W.P.W.
V. Davis - W.P.W.

EMBANKMENT ID# PA-507 Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed - High grass and heavy brush made surface observations very difficult.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Generally good with maximum crest settlements not in excess of 4 inches.	
RIPRAP FAILURES	Minor erosion of riprap--Riprap is composed of well graded air cooled slag (6-inch max.) to sand sized, placed unevenly and probably ineffective as riprap.	

EMBANKMENT ID # PA-507 SHEET 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition except for one seep (see item below).	
ANY NOTICEABLE SEEPAGE	Flow along spillway at junction of embankment. Flow apparently originates 10 feet below bench and is visually estimated to be approximately 5 gpm. Leakage is also visible through spillway indicating the source of the above seep may originate underneath the spillway.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed in embankment. Drain underneath center of spillway protrudes the surface of the concrete at about 15 feet from the stilling basin.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed - Area where 16-inch blow-off exits into plunge pool is in good condition.	
INTAKE STRUCTURE	Top visible - Some deterioration is evident but generally the structure appears to be o.k. Four valve stems portrude from top and are apparently functional as per conversations with W.P.W. personnel accompanying inspection team.	
OUTLET STRUCTURE	16-inch cast iron blow-off pipe off a 24-inch feed line to pump house. The 24-inch line is fed by a 16-inch line at the intake tower. To operate blow-off, all pumps must be shut-off and valve open.	
OUTLET CHANNEL	16-inch blow-off discharges into spillway stilling basin. Note: Stilling basin also used as a supply pool where water is pumped into the reservoir.	
EMERGENCY GATE	Blow-off valve located just outside pump house.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Ogee-shaped weir located at spillway entrance and in good condition.	
APPROACH CHANNEL	Short and shallow natural approach channel. Water level at time of inspection at approximately 3 inches below top of weir crest.	
DISCHARGE CHANNEL	Fair to good condition in upper two-thirds. Joints and popouts have been filled with bitumen. Flow surface in reasonably good condition. Seep through left side of spillway at wall causing concrete deterioration. Bottom third in poor condition with spalling and severe scaling evident. Plunge pool walls in good condition.	
BRIDGE AND PIERS	None observed.	

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	Spillway only (good condition).	
PIEZOMETERS	None observed.	
OTHERS		

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Wooded - Gentle to moderate on both sides - No problems apparent.	
SEDIMENTATION	None observed.	

DOWNSTREAM CHANNEL ID # PA-507 SHEET 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Creek is dammed about 50 feet downstream from plunge pool to create pool for withdrawing water (via pumps) to reservoir.	
SLOPES	Stream channel slope is gentle.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 20 homes on Pa. Route 18 could be effected by sudden breach. Estimated population about 80.	

APPENDIX C

HYDROLOGY AND HYDRAULICS

SUBJECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM # 4

BY DLB DATE 6-5-78 PROJ. NO. 78-501-507

CHKD. BY JTS DATE 6-8-78 SHEET NO. 1 OF 15

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LOCATION (DAM AND WATERSHED)

WASHINGTON WEST QUADRANGLE
PROSPERITY QUADRANGLE
WASHINGTON EAST QUADRANGLE
AMITY QUADRANGLE
} U.S.G.S. 7.5 MINUTE

DAM STATISTICS

MAXIMUM HEIGHT OF DAM = 63 FT

DRAINAGE AREA (REF 2, DRWG 1) = 2.25 SQ. MI (REF 2 DRWG 1)

STORAGE CAPACITY = 925 MILLION GALLONS
OR 2837 ACRE-FEET

(REF 2, DRWG 1)

SIZE CLASSIFICATION

DAM SIZE = INTERMEDIATE (REF 1, TABLE 1)

HAZARD RATING = HIGH
POSSIBLE LOSS OF LIFE IS GREATER THAN 3

REFERENCES:

1: "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS" by DEPT OF ENVIR. - CORPS OF CHIEF ENGINEER APPENDIX

2: CONTRACT DRAWINGS - CITIZENS WATER CO. by SUPERVISING ENGINEERS, INC

SUBJECT DAM SAFETY INSPECTION
WATER COMPANY DAM #4

BY DLB DATE 7-17-78 PROJ. NO. 78-501-507

CHKD. BY JPN DATE 7-19-78 SHEET NO. 7 OF 15

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$$Q_1 = \left[\frac{D_1}{D_2}\right]^n Q_2$$

Q_1 = PMF AT WATER COMPANY DAM #4

Q_2 = PMF FROM STATION AT CHARTIER'S CREEK (WASHINGTON, PA.)
= 27,200 CFS (SUPPLIED BY CORPS)

D_1 = DRAINAGE AREA WATER COMPANY DAM #4 = 2.25 SQ. MI.

D_2 = DRAINAGE AREA AT CHARTIER'S CREEK (WASHINGTON, PA.)
= 28.6 SQ. MI (SUPPLIED BY CORPS)

n = 0.6 TO 0.8 (RECOMMENDED BY CORPS)

FOR $n = 0.6$

$$Q_1 = \left[\frac{2.25}{28.60}\right]^n (27{,}200 \text{ CFS}) = 5916 \text{ CFS}$$

FOR $n = 0.8$

Q_1 = = 3558 CFS

ACTUAL Q FROM C OF E CURVE = 4275 CFS

5916 CFS > 4275 CFS > 3558 CFS

SUBJECT DAM SAFETY INSPECTION
CITIZENS WATER CO. DAM #4

BY DLD DATE 6-5-78 PROJ. NO. 78-501-507

CHKD. BY JPN DATE 7-19-78 SHEET NO. 3 OF 15

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REQUIRED SDF = PMF (REF 1, TABLE 3)

USE $n = 0.7$ (MEAN OF VALUES SUGGESTED BY COE AND SUBSTANTIATED FROM AVAILABLE OHIO RIVER BASIN DATA)

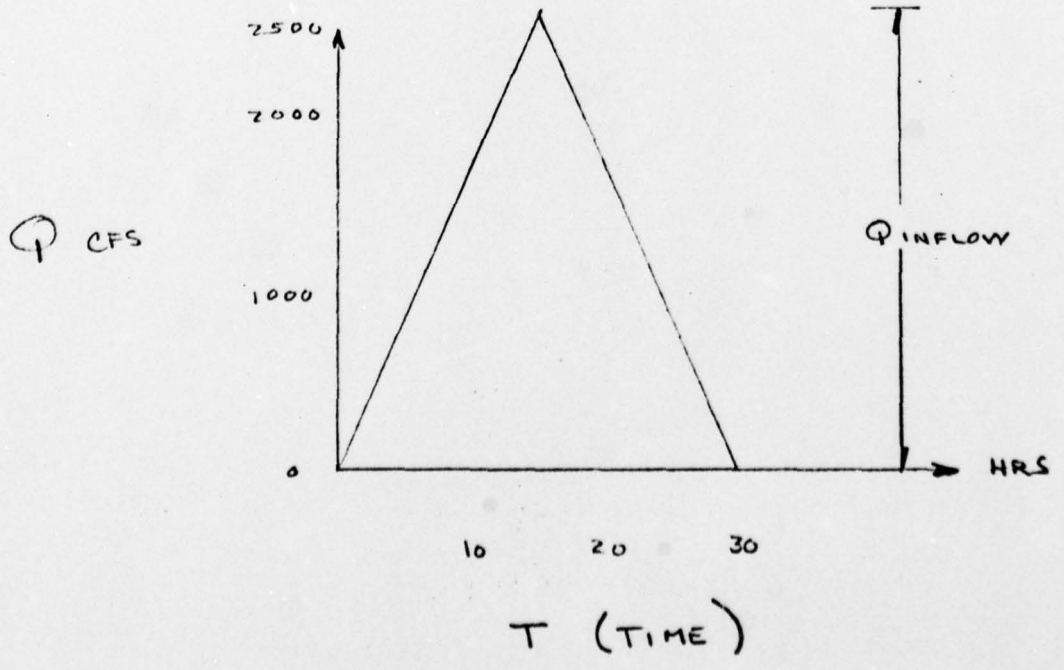
$$Q = \left[\frac{2.25}{28.60}\right]^{0.7} (27,200 \text{ CFS}) = 4,588 \text{ CFS}$$

PMF = 4588 CFS

DEVELOP INFLOW HYDROGRAPH

MAXIMUM INFLOW = 4588 CFS

TOTAL TIME OF FLOW = 34 HRS



IECT DAM SAFETY INSPECTION
CITIZENS WATER CO. DAM #4

BY DLB DATE 6-20-78 PROJ. NO. 78-501-507

CHKD. BY JPN DATE 7-19-78 SHEET NO. 4 OF 15

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VOLUME OF INFLOW FROM HYDROGRAPH

$V = \frac{1}{2}(Q_{INFLOW})(TIME)$

$= \frac{1}{2}(4588\,CFS)(34\,HRS)(3600\,SEC/HRS)(1\,ACRES/43{,}560\,SQ.FT)$

$= 6446$ ACRE-FEET

DETERMINE AVERAGE RAINFALL REQUIRED TO PRODUCE THE ABOVE VOLUME OF INFLOW.

$$\frac{\text{VOL. OF INFLOW}}{\text{DRAINAGE AREA}} = \frac{(6446\,AC\text{-}FT)(1\,SQ.MI/640\,ACRES)(12\,IN/FT)}{(2.25\,SQ.MI)} =$$

$= 53.7$ INCHES

26 INCHES IS TO BE THE UPPER LIMIT USED WHEN COMPUTING INFLOW VOLUMES.

VOLUMES PRODUCED BY VALUES GREATER THAN 26 INCHES ARE TO BE RECALCULATED.

$26\,INCHES\,(2.25\,SQ.MI)(640\,ACRE/SQ.MI)(1FT/12IN) = 3120$ ACRE-FEET

NOTE: Q_{INFLOW} REMAINS CONSTANT.
STORM DURATION IS TO DECREASE IN ACCORDANCE WITH THE DECREASE IN INFLOW VOLUME

PROJECT DAM SAFETY INSPECTION
CITIZENS WATER CO. DAM # 4

BY DLB DATE 6-5-78 PROJ. NO. 78-501-507

CHKD. BY JPN DATE 7-19-78 SHEET NO. 5 OF 15

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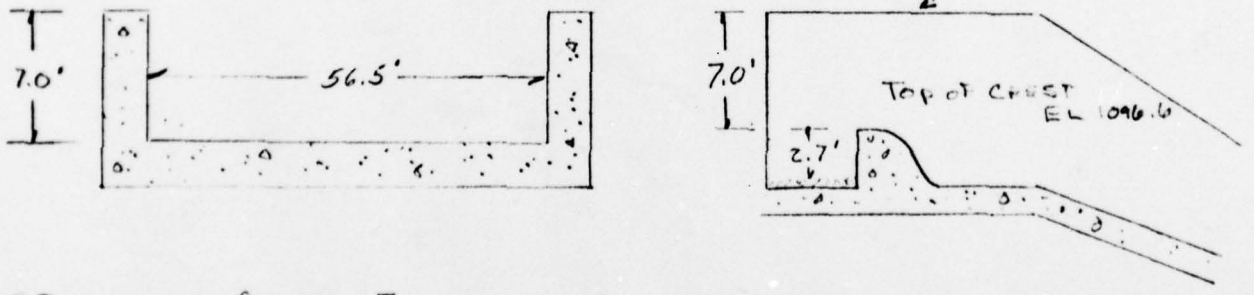
EQUIVALENT STORM DURATION $= \frac{(3120 \text{ AC-FT})(2)(43{,}560 \text{ FT}^2/1 \text{ ACRE})}{(3600 \text{ SEC/HR})(4588 \text{ CFS})} = 16.5 \text{ HRS}$

$= 16.5 \text{ HRS}$

SPILLWAY CAPACITY



SPILLWAY CREST ELEVATION = 1096.6 FT

HEAD ABOVE SPILLWAY CREST = 7.0 FT (FIELD OBSERVATION)

NOTE: ALL ELEVATIONS ARE TAKEN FROM DRWG 2 OF 5 DATED 5-20-35. SPILLWAY DIMENSIONS WERE MEASURED IN THE FIELD DURING INSPECTION.

PROJECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM #4

BY DLB DATE 6-5-78 PROJ. NO. 78-501-507

CHKD. BY JTS DATE 6-8-78 SHEET NO. 6 OF 15

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$Q = C L H^{3/2}$ (REF 3, EQ 21-121)

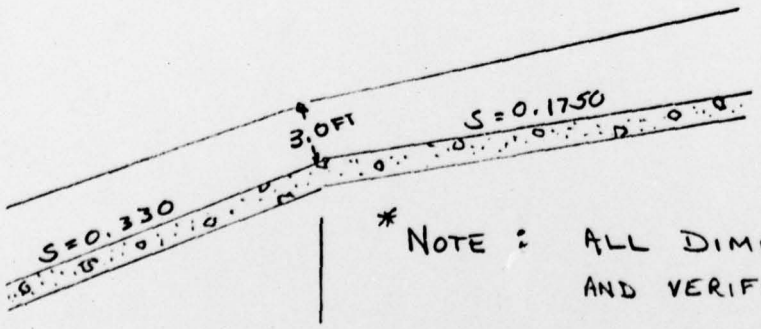
(FROM FIG 21-67, REF 3) $P/H_D = (2.7\text{FT})/7.0\text{FT} = 0.3857$

$\therefore \quad C = 3.75$

$Q = (3.75)(56.5\text{FT})(7.0\text{FT})^{3/2} = 3924\text{ CFS}$

CHECK OTHER POSSIBLE POINTS OF CONTROL

AT STA 1+80 AS INDICATED ON DRWG 4 REF 2



STA 1+80

*NOTE: ALL DIMENSIONS WERE TAKE AND VERIFIED IN THE FIELD

REF 3: "STANDARD HANDBOOK FOR CIVIL ENGINEERS" by F.S. MERRITT

ECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM #4

BY DLB DATE 6-5-78 PROJ. NO. 78-501-507
CHKD. BY JTS DATE 6-8-78 SHEET NO. 7 OF 15

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$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2} \qquad \text{(REF 3, EQ 21-90)}$$

S = SLOPE ABOVE CONTROL POINT = 0.175
R = HYDRAULIC RADIUS

$$= \frac{\text{AREA OF FLOW}}{\text{WETTED PERIMETER}} = \frac{(20\text{FT})(X)}{(20\text{FT} + 2X)}$$

A = AREA OF FLOW = $(20\text{FT})(X)$

n = ROUGHNESS COEFFICIENT = 0.015 (REF 3, TABLE 21-11)
CONCRETE WITH FLOAT FINISH

$Q = CL H^{3/2}$ = 3924 CFS (SHEET 5)

$$3924\text{cfs} = \frac{1.486}{(0.015)} (20X) \left[\frac{(20X)}{(20+2X)}\right]^{2/3} (0.175)^{1/2}$$

$$3924 = 828.9\, X \left[\frac{(20X)}{(20+2X)}\right]^{2/3}$$

$$24\,5807 = 23{,}864.5\, X^{3/2} \left[\frac{20X}{(20+2X)}\right]$$

$$4{,}916{,}140 + 491{,}614X = 477290\, X^{5/2}$$

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$10 + X = .971 X^{5/2}$

$0 = .971 X^{5/2} - X - 10$

$2.75' < X < 2.8'$

∴ THE POINT OF CONTROL FOR THIS SPILLWAY IS AT THE OVERFLOW WEIR AT ENTRANCE

PMF (PEAK INFLOW) = 4275 CFS = SDF

MAXIMUM SPILLWAY DISCHARGE = 3924 CFS

PMF (PEAK INFLOW) > MAXIMUM SPILLWAY DISCHARGE
4588 CFS > 3924 CFS

TOTAL DISCHARGE CAPACITY (INCLUDING OUTLETS) =

= 3924 + 63 = 3987

(SHEET 14) 5

SUBJECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM # 4

BY DLB DATE 6-5-78 PROJ. NO. 78-501-507

CHKD. BY JPN DATE 6-9-78 SHEET NO. 9 OF 15

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CONSIDER INFLOW RELATIVE TO BOTH OUTFLOW AND STORAGE USING SHORT CUT METHOD AS RECOMMENDED BY NAD

$$P = \frac{\text{MAXIMUM SPILLWAY DISCHARGE}}{\text{PMF PEAK INFLOW}} = \frac{3924}{4588}$$ (SHEET 5) (SHEET 2)

$P = 0.86$

$$(1-P) = \frac{\text{REQ'D RESERVOIR STORAGE}}{\text{VOL. OF INFLOW HYDROGRAPH}} = (1-0.86) = 0.14$$

VOL. OF INFLOW HYDROGRAPH = 3122 ACRE-FT (SHEET 3)

$\therefore (0.14)(3122 \text{ AC-FT}) = 437 \text{ ACRE-FT}$

REQ'D RESERVOIR STORAGE = 437 AC-FT

APPROXIMATE AVAILABLE STORAGE

CAPACITY AT EL 1096.6 = 925 MIL GAL (REF 2: DRWG 1)
CAPACITY AT EL 1103.6 = 1150 MIL GAL (ESTIMATED)

TOP OF DAM (EL 1103.6)

NOTE: CONTRACT DRAWINGS REFER TO EL 1103.6 CONSISTENTLY AS THE TOP OF DAM ELEVATION EVEN THOUGH THE CREST SLOPES FROM 1103.35 TO 1103.85. THUS 1103.6 IS THE AVERAGE HEIGHT OF CREST AND WILL BE CONSIDERED AS TOP OF DAM IN ORDER TO REMAIN CONSISTENT WITH OTHER CONTRACT DOCUMENTS.

PROJECT DAM SAFETY INSPECTION
CITIZENS WATER CO. #4

BY DLP DATE 6-5-78 PROJ. NO. 78-501-507

CHKD. BY JPL DATE 6-9-78 SHEET NO. 10 OF 15

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STORAGE AVAILABLE IS THUS IN EXCESS OF

$(1150 \text{ MIL GAL} - 925 \text{ MIL GAL}) = 225 \times 10^6 \text{ GAL}$

OR

$$\left[\frac{225 \times 10^6 \text{ GAL}}{3.26 \times 10^5 \text{ GAL/AC-FT}}\right] = 690 \text{ ACRE-FT}$$

STORAGE AVAILABLE > STORAGE REQ'D

690 AC-FT > 437 AC-FT

PROJECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM #4

BY DLB DATE 6-6-78 PROJ. NO. 78-501-502

CHKD. BY JTS DATE 6-8-78 SHEET NO. 11 OF 15

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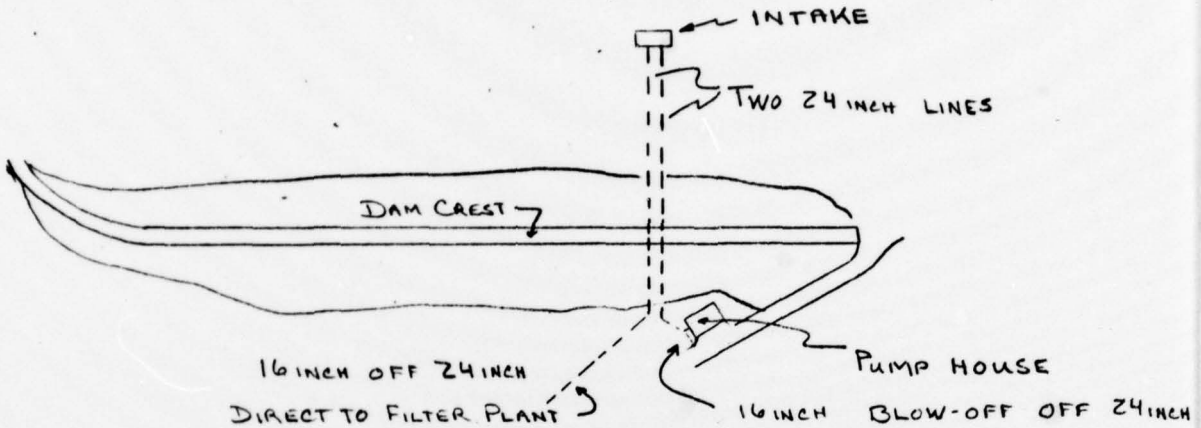
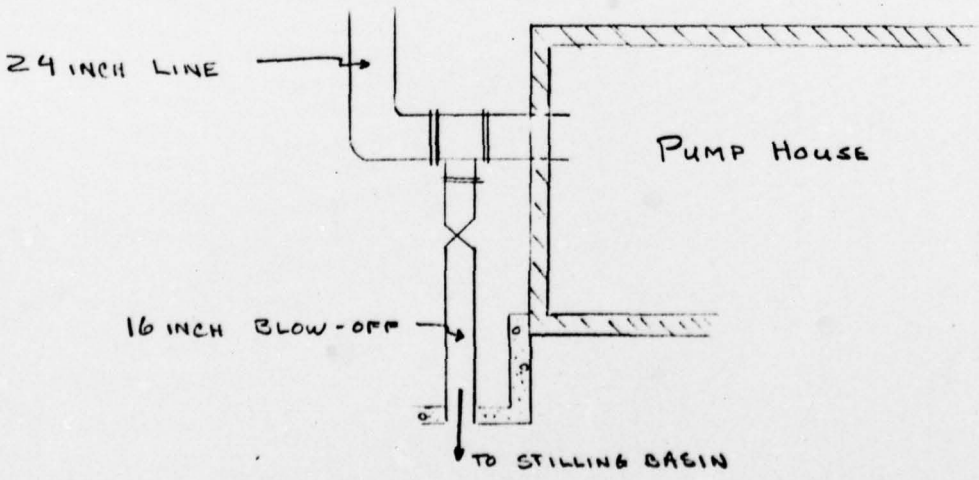
CALCULATE DISCHARGE CAPACITY OF 16 INCH ϕ BLOWOFF



PLAN (REF 2: DRWG 2)



DETAIL (REF 2: DRWG 5)

PROJECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM # 4

BY DLB DATE 6-6-78 PROJ. NO. 78-501-507

CHKD. BY JTS DATE 6-8-78 SHEET NO. 12 OF 15

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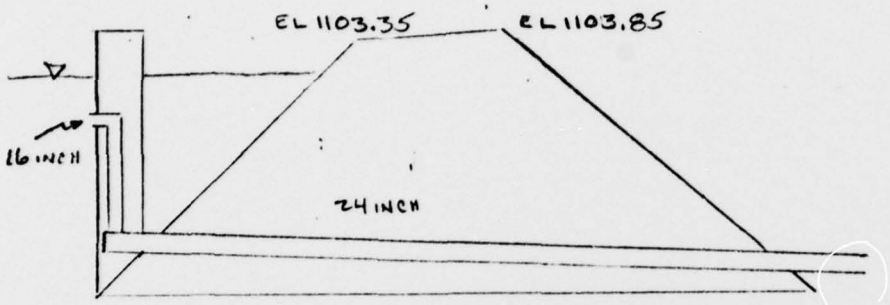
SLOPING CREST (REF 2 DRWG 3)



DRWG 6 SHOWS THE 24 INCH PIPE TO BE FED BY A 16 INCH PIPE AT THE INTAKE. CONSEQUENTLY THE MAXIMUM DISCHARGE OF THE 16 INCH BLOW-OFF DOWNSTREAM CAN BE NO GREATER THAN THE MAXIMUM DISCHARGE CAPACITY OF THE 16 INCH AT THE INTAKE. BELOW IS CALCULATED THE DISCHARGE OF THE 16 INCH AT INTAKE. IT MUST BE POINTED OUT THAT THIS CALCULATED DISCHARGE WILL NOT BE ACHIEVED AT THE DOWNSTREAM BLOW-OFF DUE TO HEAD LOSSES FROM VALVES, BENDS, AND PIPE ROUGHNESS INCURRED BETWEEN THE INLET AND OUTLET.

USE BERNOULLI'S EQUATION (REF 3, EQ 21-12)

$$Z_1 + P_1/\omega + V_1^2/2g = Z_2 + P_2/\omega + V_2^2/2g + h_f + h_e + h_v$$

INLET ELEVATION (CENTER OF PIPE) - 1081.6
OUTLET ELEVATION (TOP OF PIPE) - 1037.8
} (REF 2, DRWG 6)

PROJECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM #4

BY DLB DATE 6-6-78 PROJ. NO. 78-501-502

CHKD. BY JTS DATE 6-8-78 SHEET NO. 13 OF 15

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PLACE REFERENCE DATUM AT EL 1037.8 (OUTLET ELEVATION).

Z_1 = HEIGHT OF INLET ABOVE DATUM = 43.8 FT

Z_2 = HEIGHT OF OUTLET ABOVE DATUM = 0

P_1/ω = PRESSURE HEAD AT INLET (ASSUMING MAXIMUM HEAD) = (1101.6 - 1081.6) = 20.0 FT

P_2/ω = PRESSURE HEAD AT OUTLET = 0

V_1 = VELOCITY AT INLET = 0

V_2 = VELOCITY AT OUTLET = SOLVE FOR

g = GRAVITATIONAL CONSTANT = 32.2 FT/SEC²

h_f = HEAD LOSS DUE TO FRICTION

$$h_f = f\frac{LV^2}{2gD}$$ (REF 3, EQ 21-30)

WHERE L = LENGTH OF PIPE (43.8 FT + 7.5 FT) = 51.3 FT
(VERTICAL + HORIZONTAL)

D = PIPE DIAMETER (16 INCH) = 1.3 FT

f = 0.018 BASED ON A ROUGHNESS COEFFICIENT ε EQUAL TO 0.00085 (REF 3, TABLE 21-3) AND A REYNOLD'S NUMBER OF 1.0×10^7 FOR TURBULENT FLOW. (REF 3, FIG 21-19)

ε/D = 0.00065

ECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM #4

BY DLB DATE 6-6-78 PROJ. NO. 78-501-507

CHKD. BY JTS DATE 6-8-78 SHEET NO. 14 OF 15

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h_e = HEAD LOSS AT ENTRANCE

$$h_e = K_E \frac{V^2}{2g}$$ (REF 3, EQ 21-42)

K_E = FRICTION COEFFICIENT FOR BELLMOUTH ENTRANCE = 0.05 (REF 3, TABLE 21-7)

h_v = HEAD LOSS DUE TO VALVES AND/OR FITTINGS

$$h_v = K_v \frac{V^2}{2g}$$ (REF 3, EQ 21-42)

K_v = FRICTION COEFFICIENT FOR GATE VALVE, FULLY OPEN = 0.2 (REF 3, TABLE 21-8)

SOLVE BERNOULLI'S EQUATION

$$43.8 + 20 + 0 = 0 + 0 + \frac{V^2}{2(32.2)} + \frac{(0.018)(513)V^2}{2(32.2)(1.3)} + \frac{(0.05)V^2}{2(32.2)} + \frac{(0.2)V^2}{2(32.2)}$$

$$63.8 = (0.016 + 0.011 + 0.001 + 0.003)V^2$$

$$63.8 / 0.03 = V^2$$

$$V = 45.4 \text{ FPS}$$

PROJECT DAM SAFETY INSPECTION
CITIZEN'S WATER CO. DAM #4

BY DLB DATE 6-6-78 PROJ. NO. 78-501-507

CHKD. BY JTS DATE 6-8-78 SHEET NO. 15 OF 15

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$Q = VA$

$Q = (45.4 \text{ FPS})(\pi)(0.67 \text{ FT})^2 = 63.4 \text{ CFS}$

CONCLUDE: DISCHARGE FROM THE 16 INCH BLOW-OFF WILL NOT EXCEED APPROXIMATELY 63 CFS

APPENDIX D

PHOTOGRAPHS

PHOTOGRAPH 1 View of the Dam #4 embankment from the right abutment.

PHOTOGRAPH 2 View of the upstream portion of the Dam #4 embankment. The outlet structure is shown near the center of the photograph.

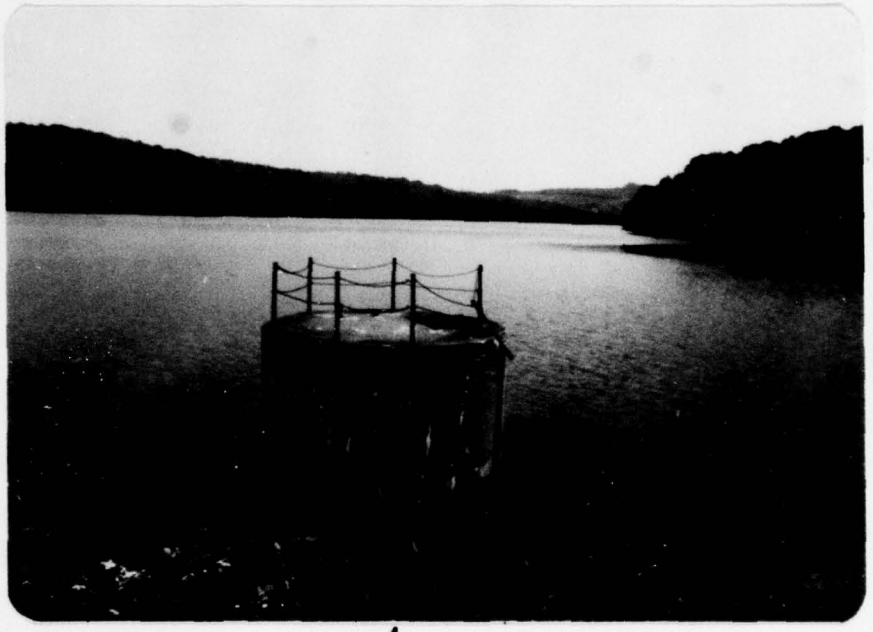
PHOTOGRAPH 3 View of the downstream portion of the Dam #4 embankment taken from the area just downstream of the right abutment. A portion of the spillway apron is visible in the background (center) of the photograph.

PHOTOGRAPH 4 Close-up view of the outlet controls at Dam #4. The gates are reportedly kept open and flow is said to be regulated at the treatment plant.

1

2

3



4

PHOTOGRAPH 5 View of the spillway at Dam #4 taken from the plunge pool area. Note the deteriorated condition of the structure near the entrance to the plunge pool.

PHOTOGRAPH 6 View of the spillway, plunge pool, and pump house taken from the spillway crest.

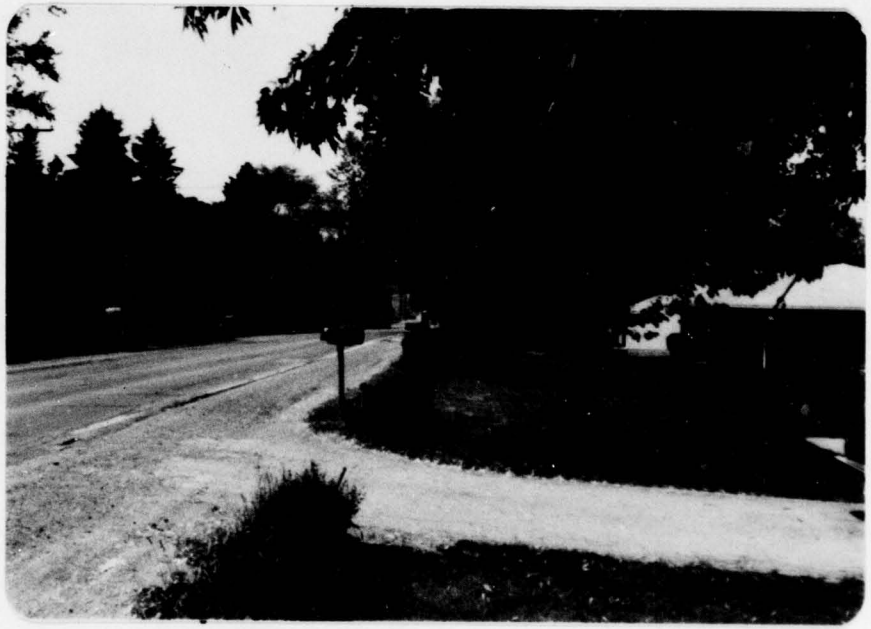
PHOTOGRAPH 7 View of seepage emanating adjacent the spillway sidewall approximately 10 feet below the embankment bench level.

PHOTOGRAPH 8 View of a residential area located approximately 2,000 feet downstream of the dam.

5

6

7



8

APPENDIX E

GEOLOGY

GEOLOGY

Water Company #4 is located in an area of nearly flat lying sedimentary rocks of the Pennsylvanian Age Washington Formation. These strata are characterized predominantly as sandstone and shales with lesser amounts of coal and limestone.

According to a summary report titled "Ground-Water Resources of Washington County, Pennsylvania", the rocks of the Washington Formation are poor producers of water because of the abundance of shale members and the scarcity of fractures.

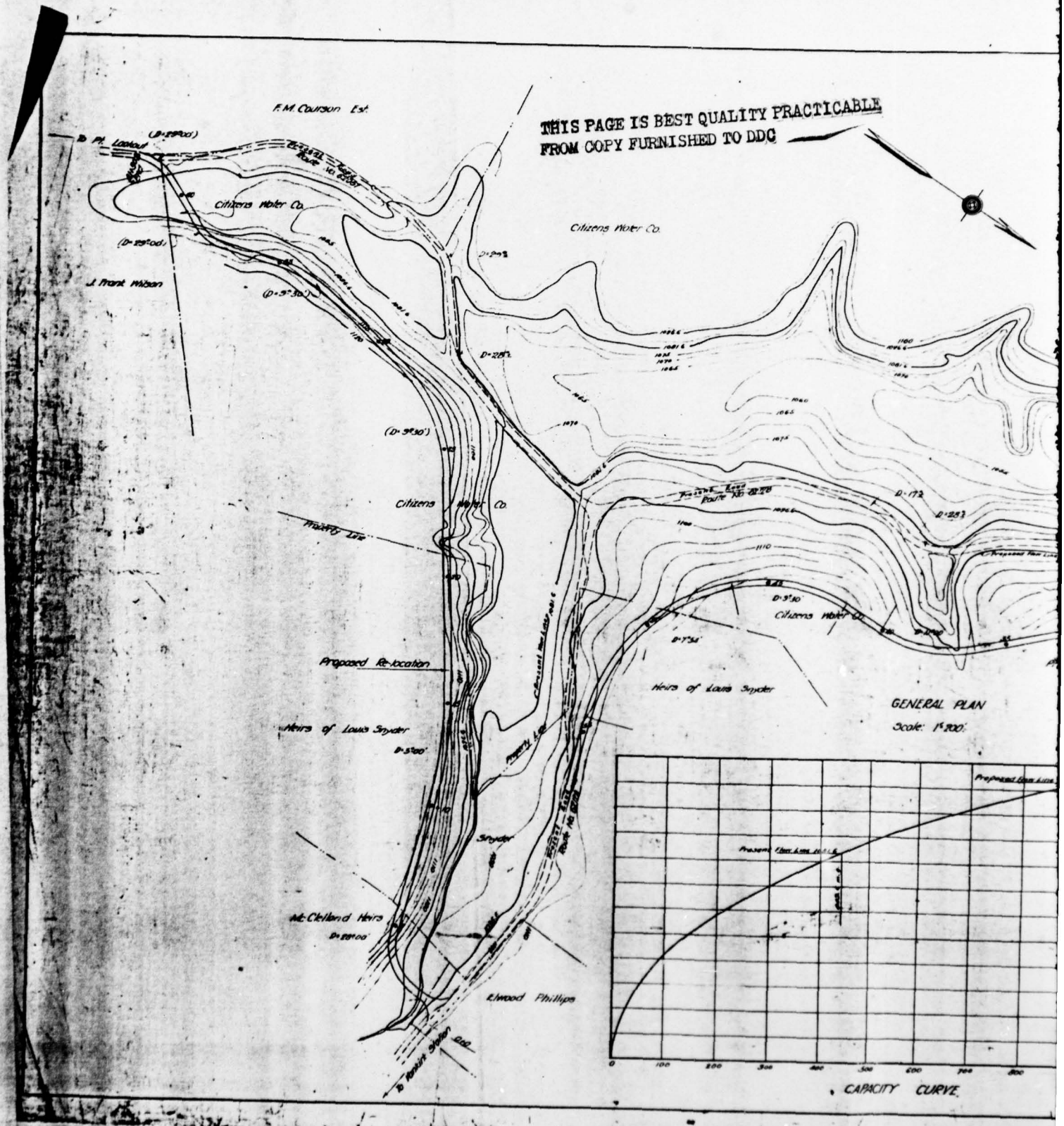
Figure 2 (Appendix F) provides information on the subsurface geology at the Water Company #4 site.

APPENDIX F

FIGURES

APPENDIX F - FIGURES

Figure	Description/title
1	General Plan and Capacity Curve
2	General Plan and Longitudinal Section
3	Typical Sections
4	Plan, Profile of Spillway and Miscellaneous Sections
5	Details of Pumping System
6	Outlets, Sections and Details



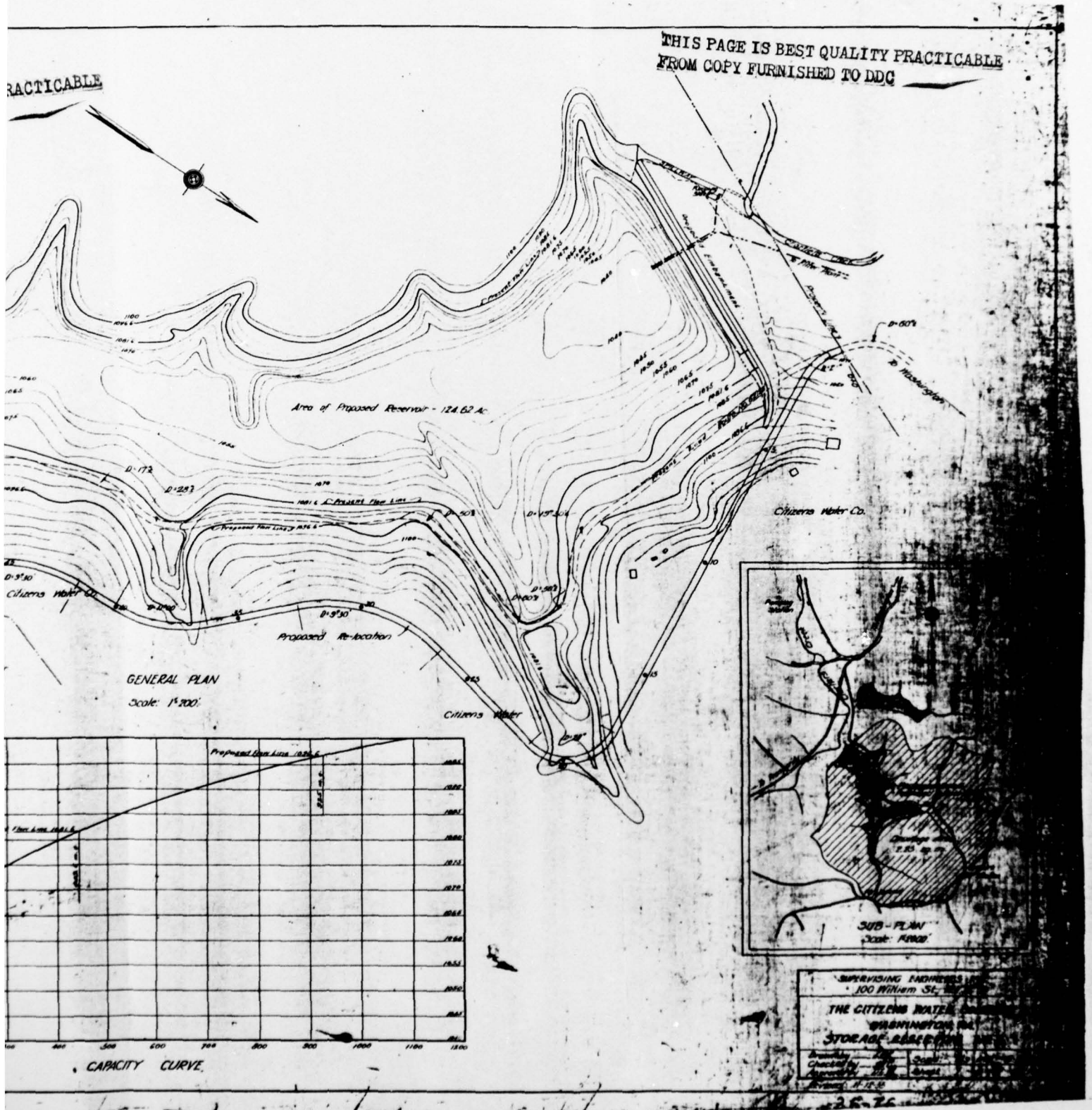
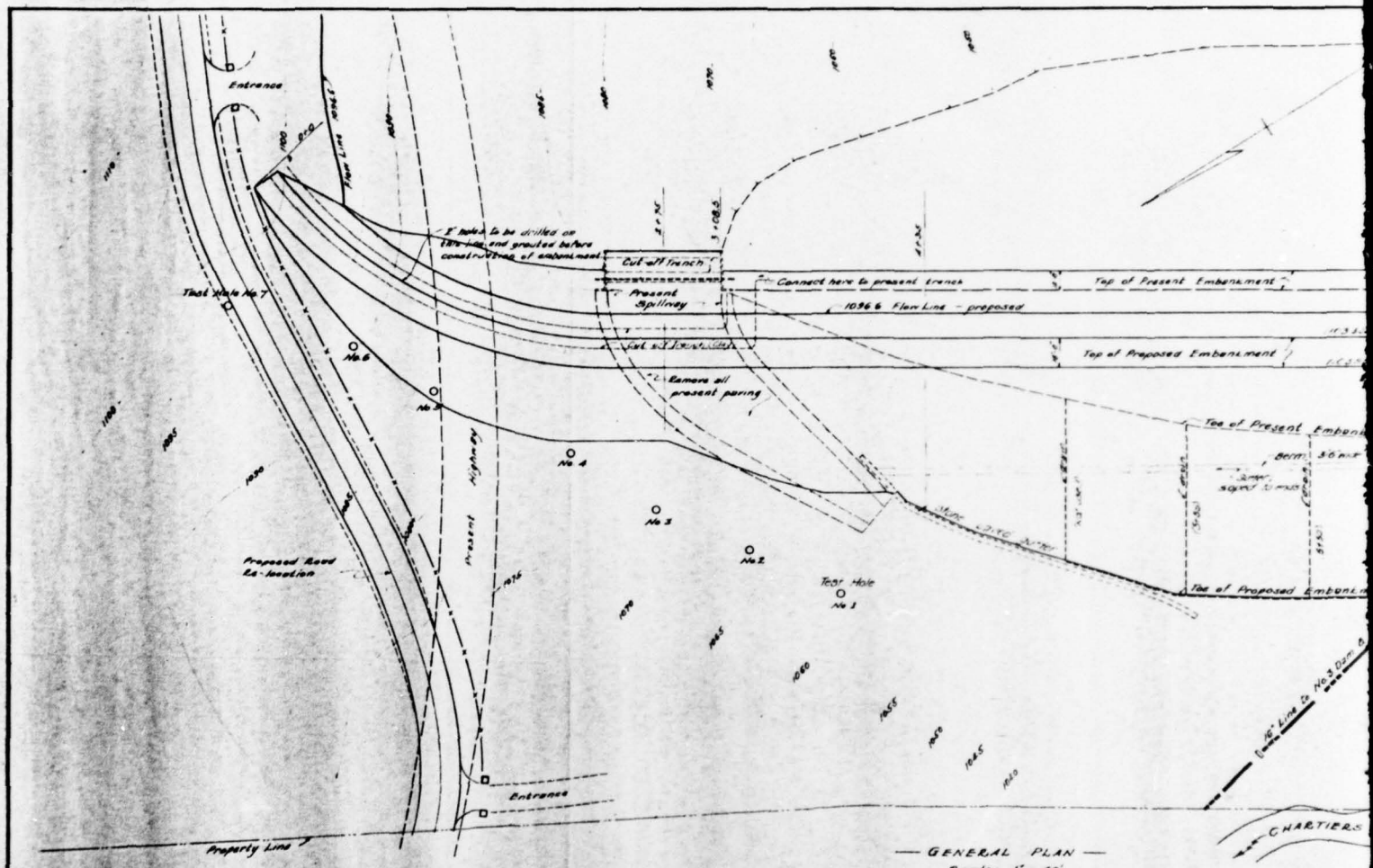
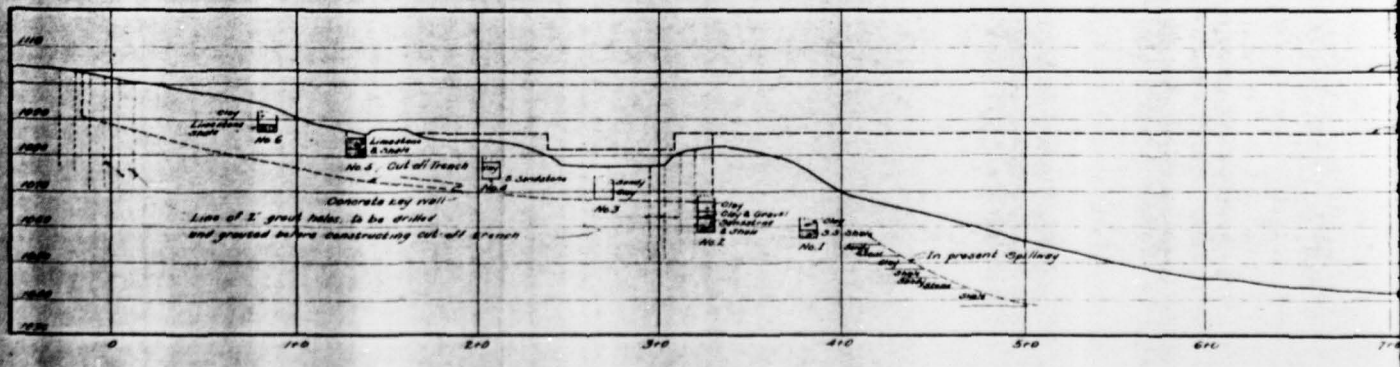


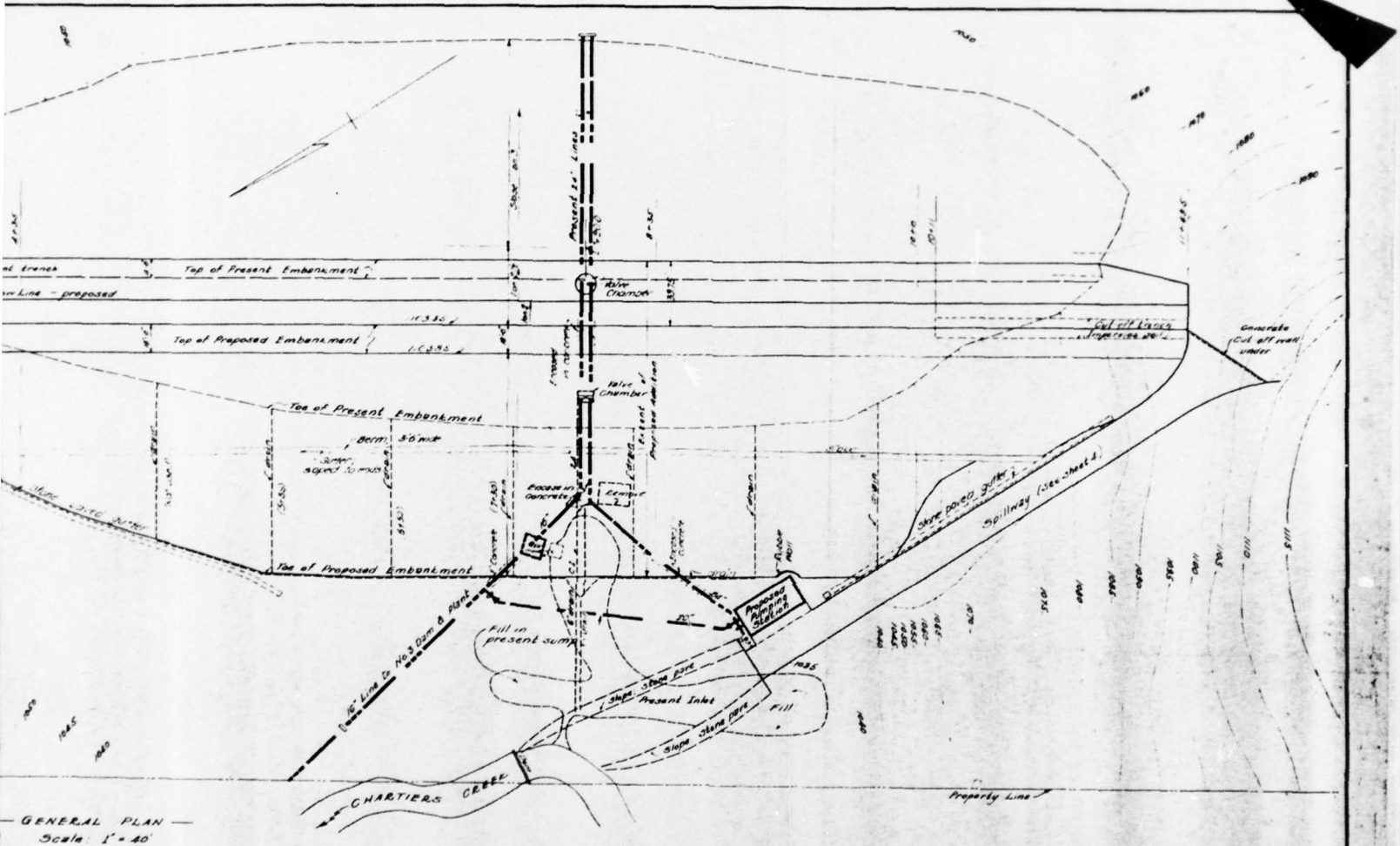
FIGURE 1



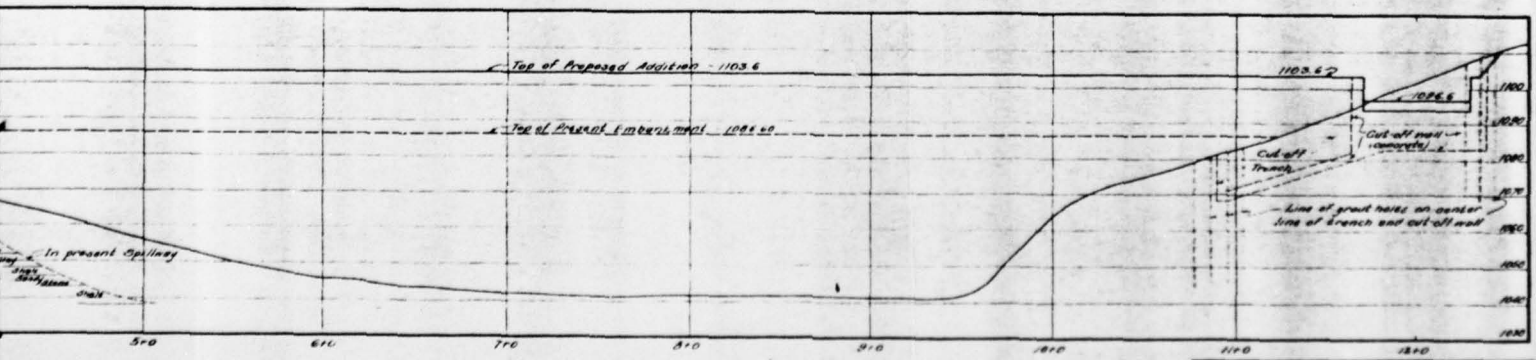
— GENERAL PLAN —
Scale: 1" = 40'



— LONGITUDINAL SECTION —
Scale: Ver. 1" = 20'
Hor. 1" = 40'



— GENERAL PLAN —
Scale: 1" = 40'



— LONGITUDINAL SECTION —
Scale: Ver. = 1" = 20'
Hor. = 1" = 40'

SUPERVISING ENGINEERS INC
100 Wilson St. NYC
THE CITIZENS WATER COMPANY
WASHINGTON, PA
STORAGE RESERVOIR NO. 4
Drawn by E.J.
Checked by E.J.
Approved by E.B.
Scale As shown
Sheet 1 of 5

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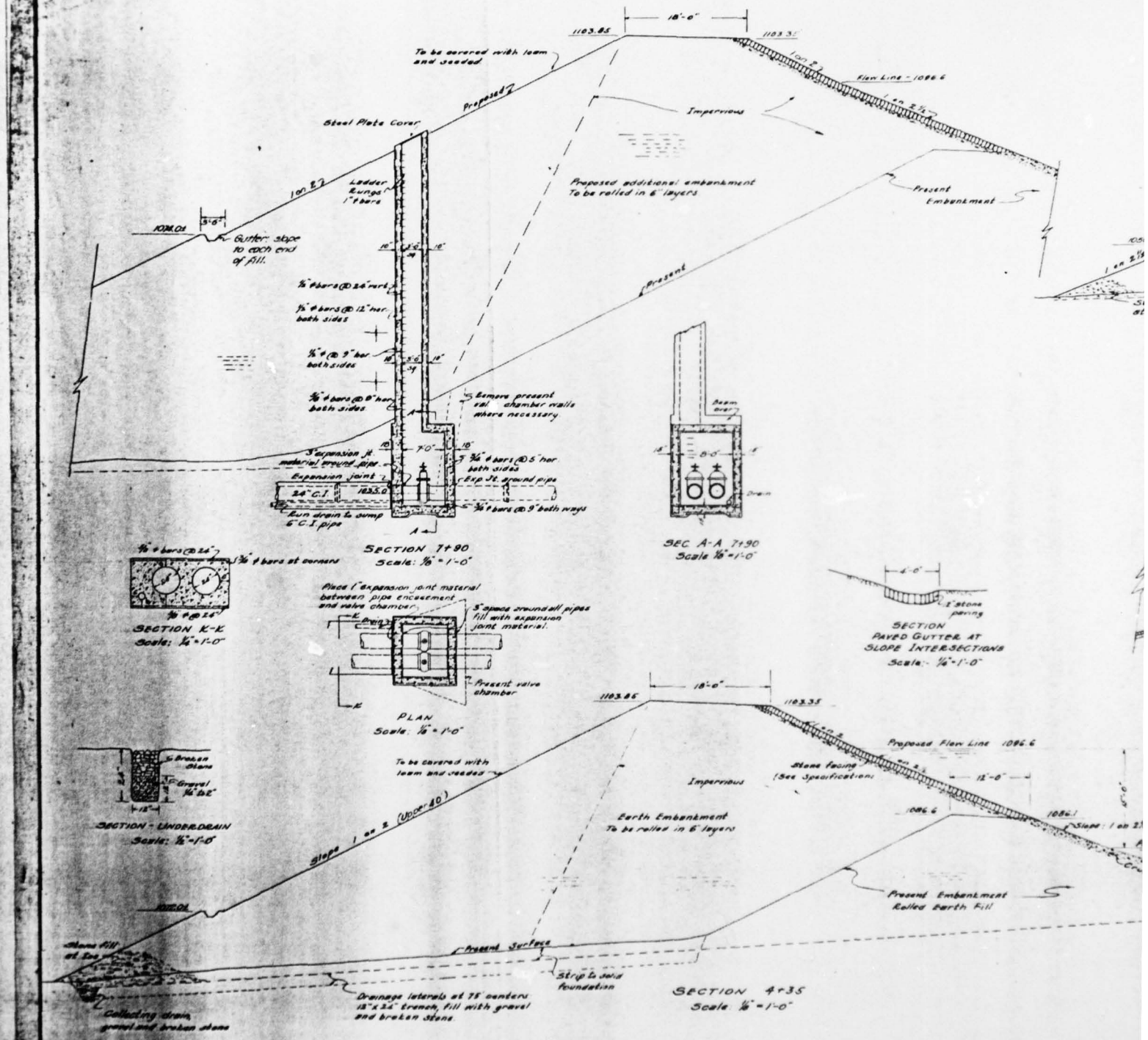
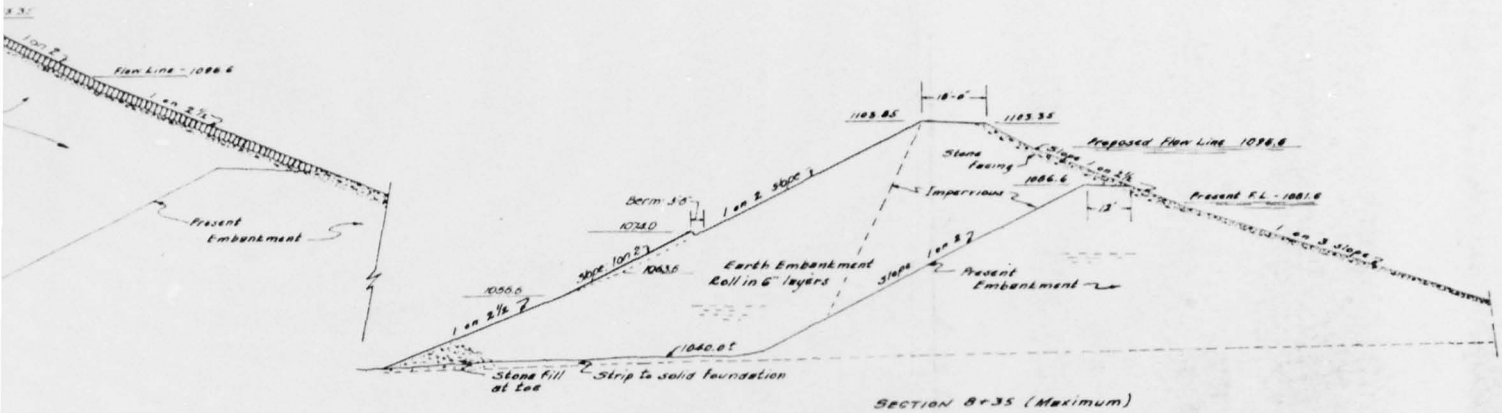
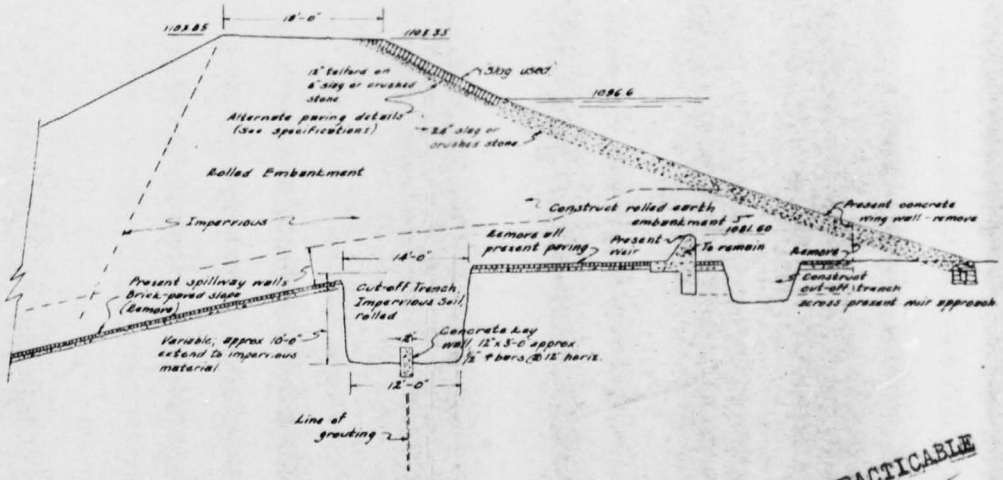
FIGURE 2

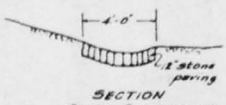




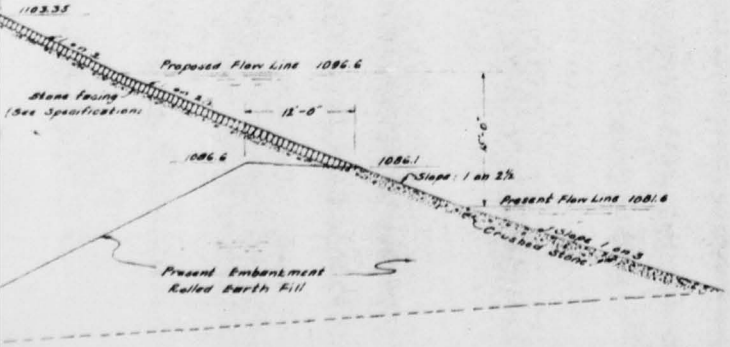
SECTION 8+35 (Maximum)
Scale: 1"=20'



SECTION 2+75
Scale: 1/8" = 1'-0"



SECTION
PAVED GUTTER AT
SLOPE INTERSECTIONS
Scale: 1/4"-1'-0"



SUPERVISING ENGINEERS INC. 100 William St, N.Y.C.	
THE CITIZENS WATER COMPANY WASHINGTON, PA. STORAGE RESERVOIR NO. 4	
Drawn by B.O.H.	Scale As ind. 4-30-35
Checked by H.E.	
Approved by [illegible]	Sheet 3 of 5
Revised 2-15-36.	

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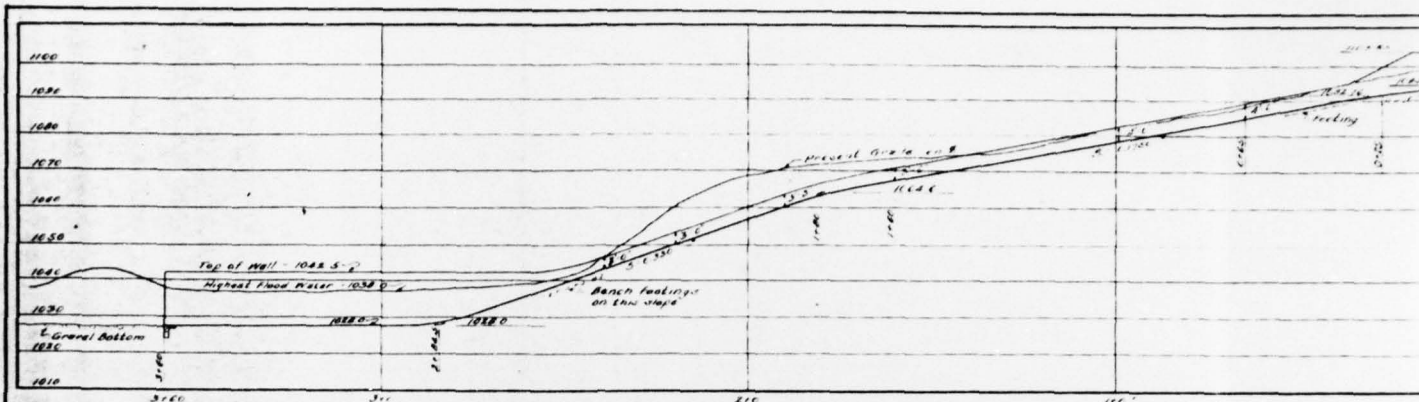
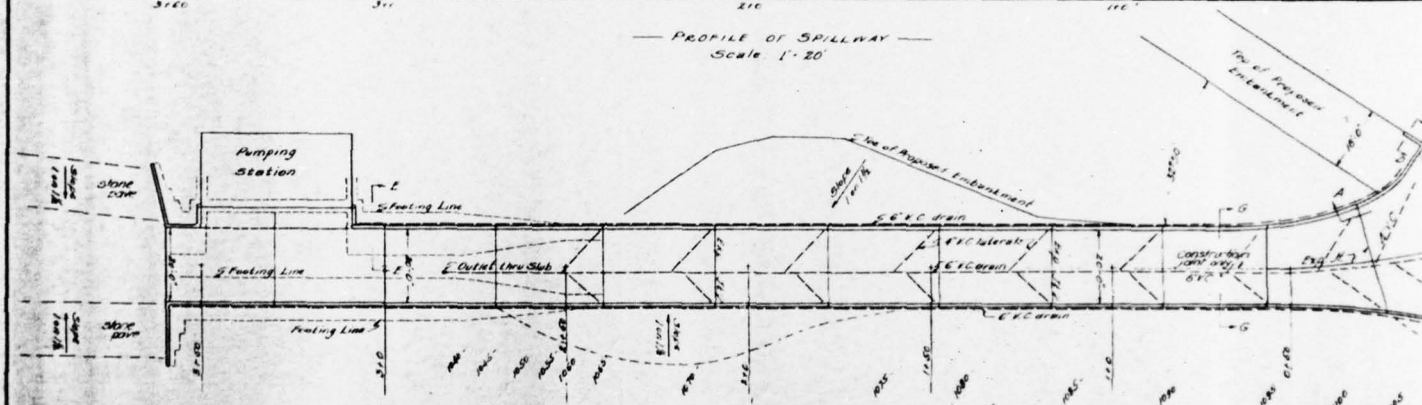
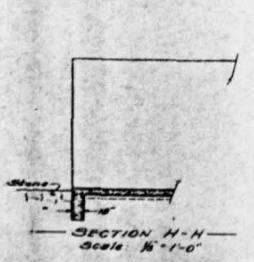
FIGURE



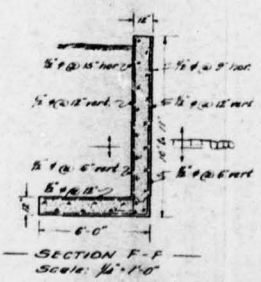
— PROFILE OF SPILLWAY —
Scale: 1" = 20'



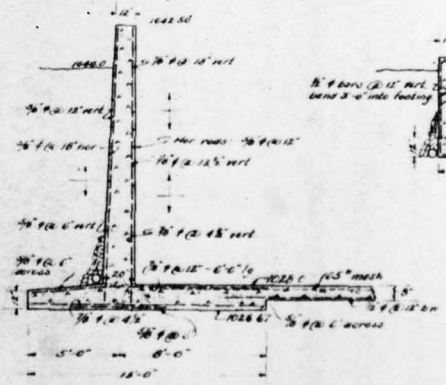
— PLAN OF SPILLWAY —
Scale: 1" = 20'



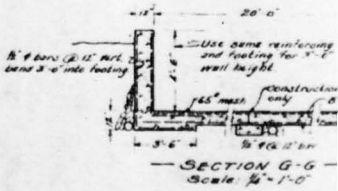
— SECTION H-H —
Scale: ½" = 1'-0"



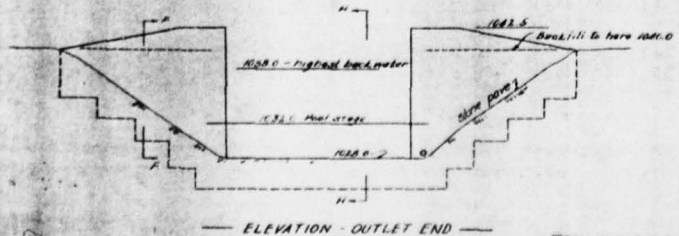
— SECTION F-F —
Scale: ½" = 1'-0"



— SECTION E-E —
Scale: ½" = 1'-0"



— SECTION G-G —
Scale: ½" = 1'-0"



— ELEVATION - OUTLET END —
Scale: ½" = 1'-0"

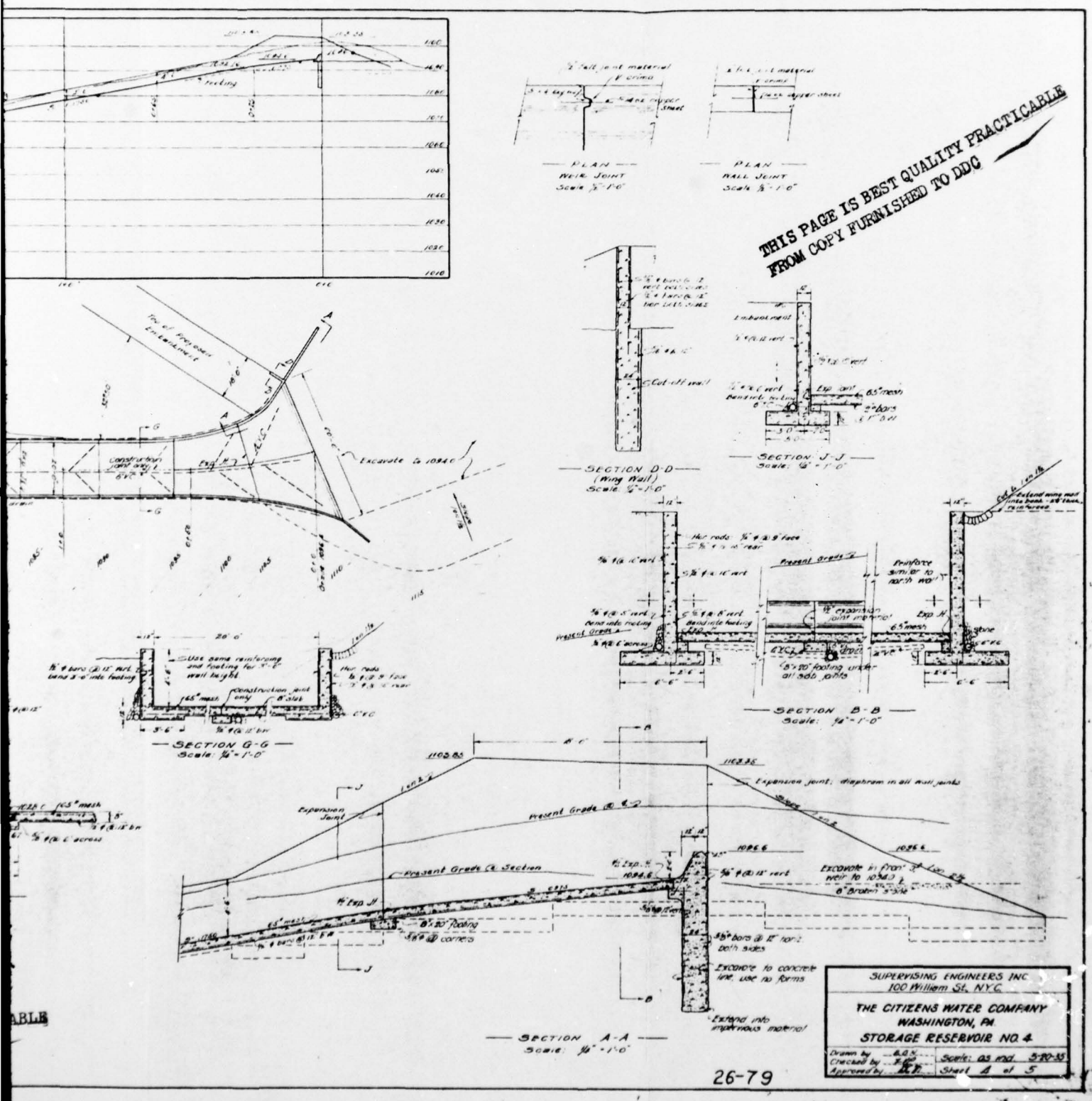


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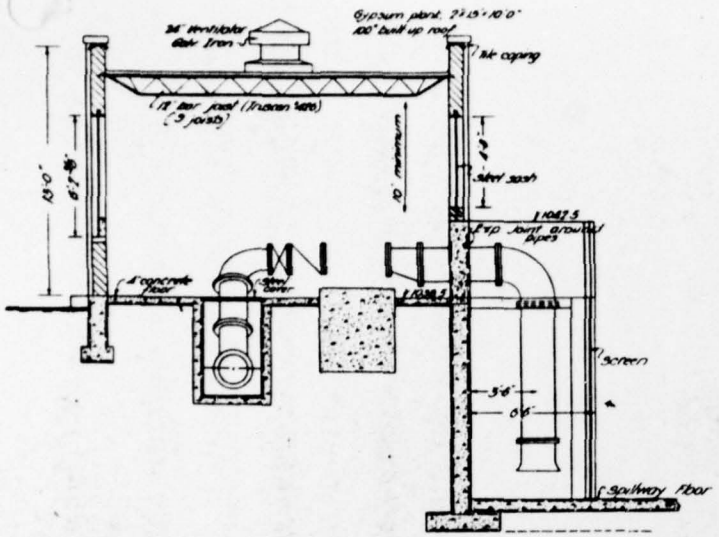
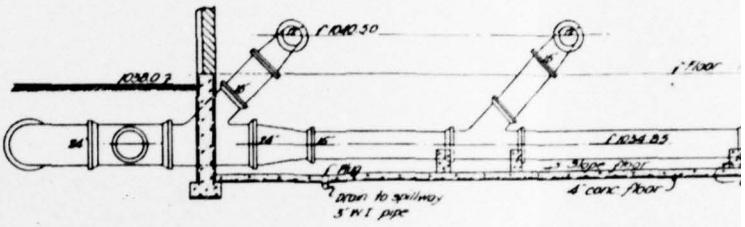
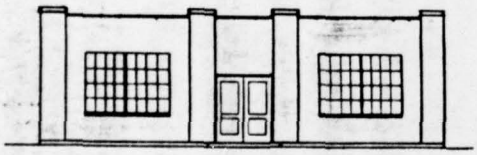
FIGURE 4



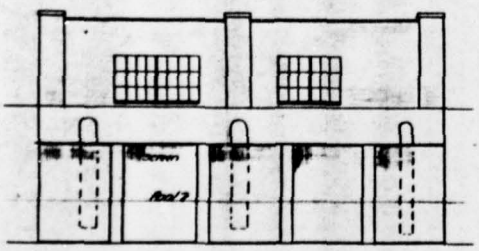
SEC. B-B
Scale: 1/4" = 1'0"



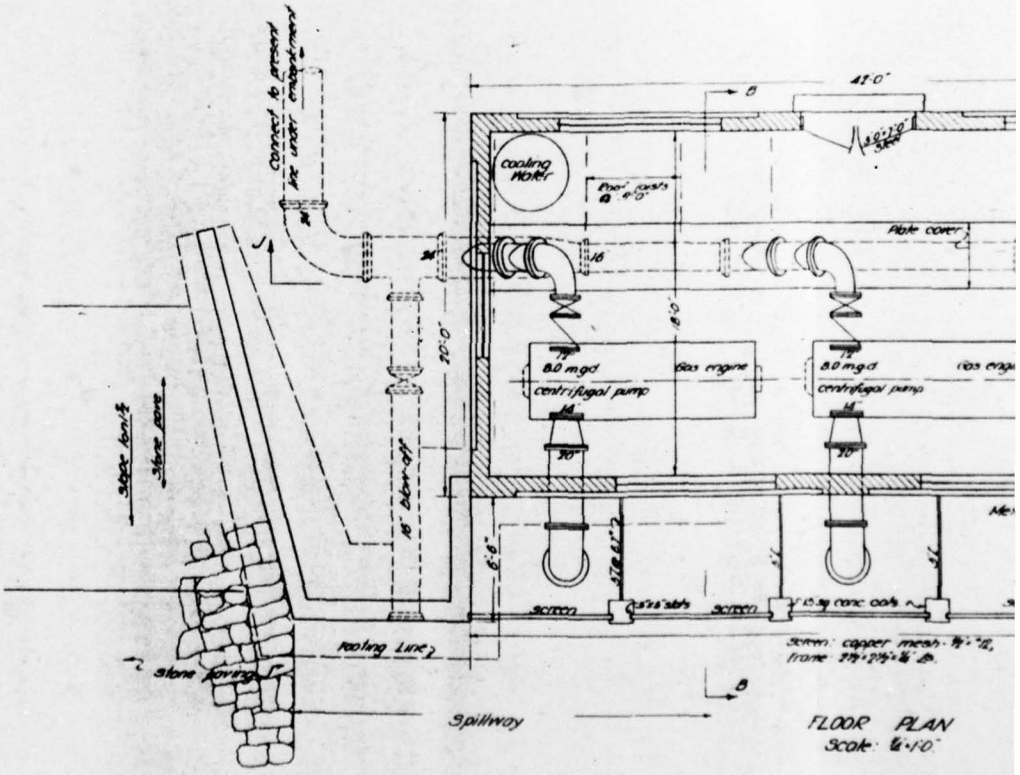
SECTION J-J
Scale 1/4" = 1'0"



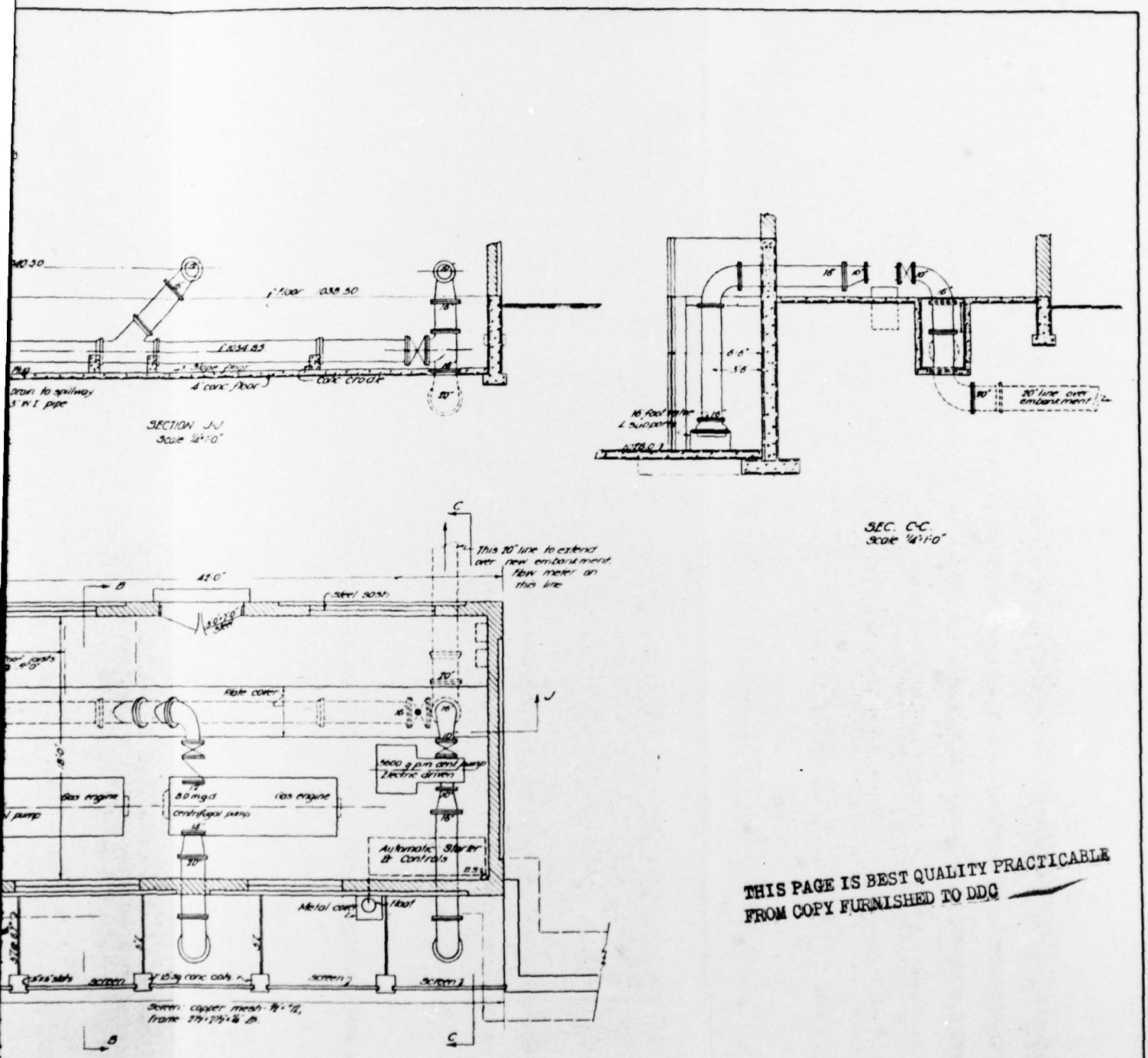
EAST ELEVATION
Scale: 1/8" = 1'0"



WEST ELEVATION
Scale: 1/8" = 1'0"



FLOOR PLAN
Scale: 1/4" = 1'0"



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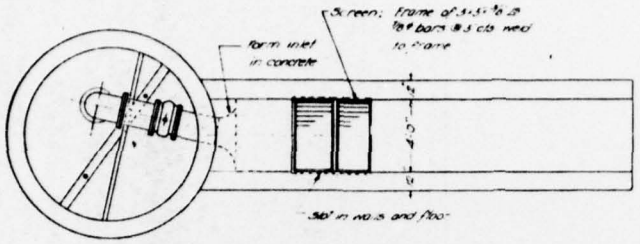
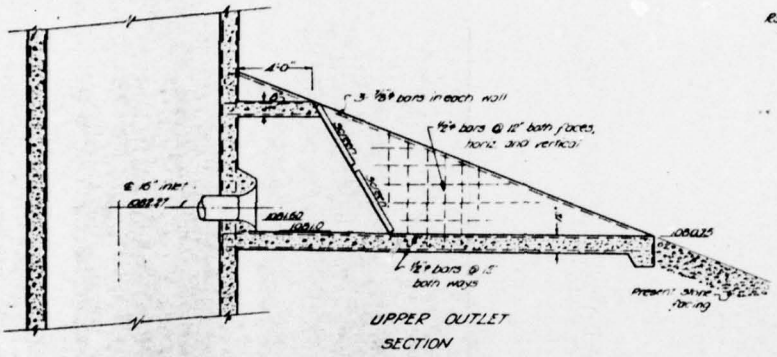
THE CITIZENS WATER COMPANY WASHINGTON, PA. STORAGE RESERVOIR NO. 4
Drawn by J.C.S. — Scale: As noted — 4-23-35 Checked by J.C. — Sheet 5 of 5 Approved by J.C.F.

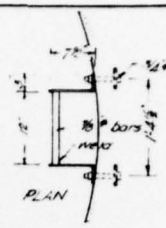
FIGURE 5

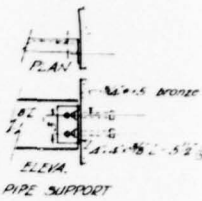


PLAN

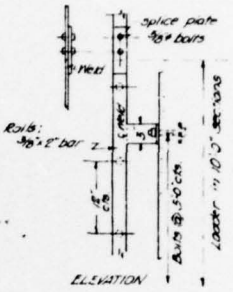


UPPER OUTLET SECTION
Scale: 1/8" = 1'-0"

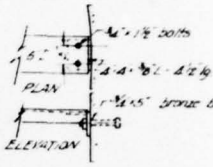




PIPE SUPPORT

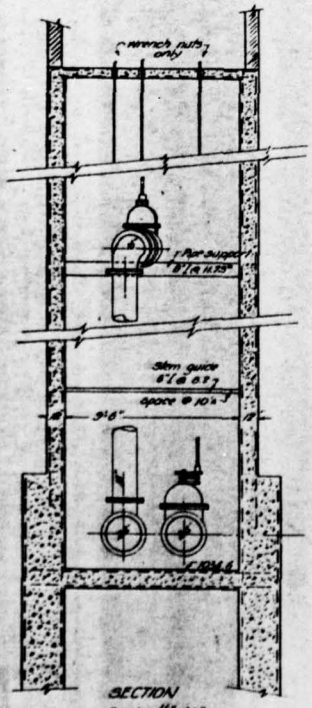


ELEVATION
LADDER

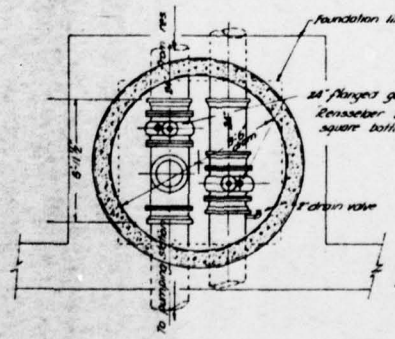


STEM GUIDE

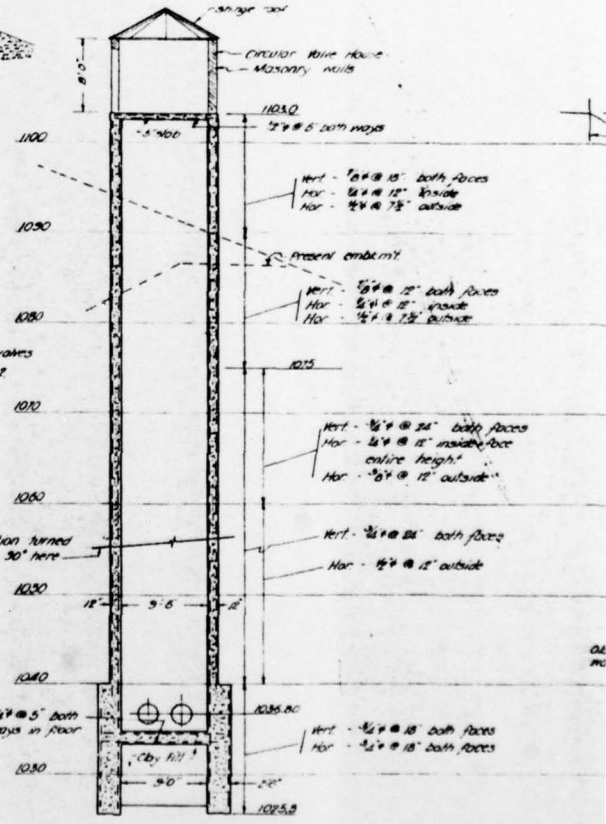
CONSTRUCTION DETAILS
Scale: 1"=1'-0"



SECTION
Scale: 1/8" = 1'-0"



PLAN
Scale: 1/8" = 1'-0"



SECTIONAL ELEVATION
REINFORCING DETAILS
Scale: 1/8" = 1'-0"

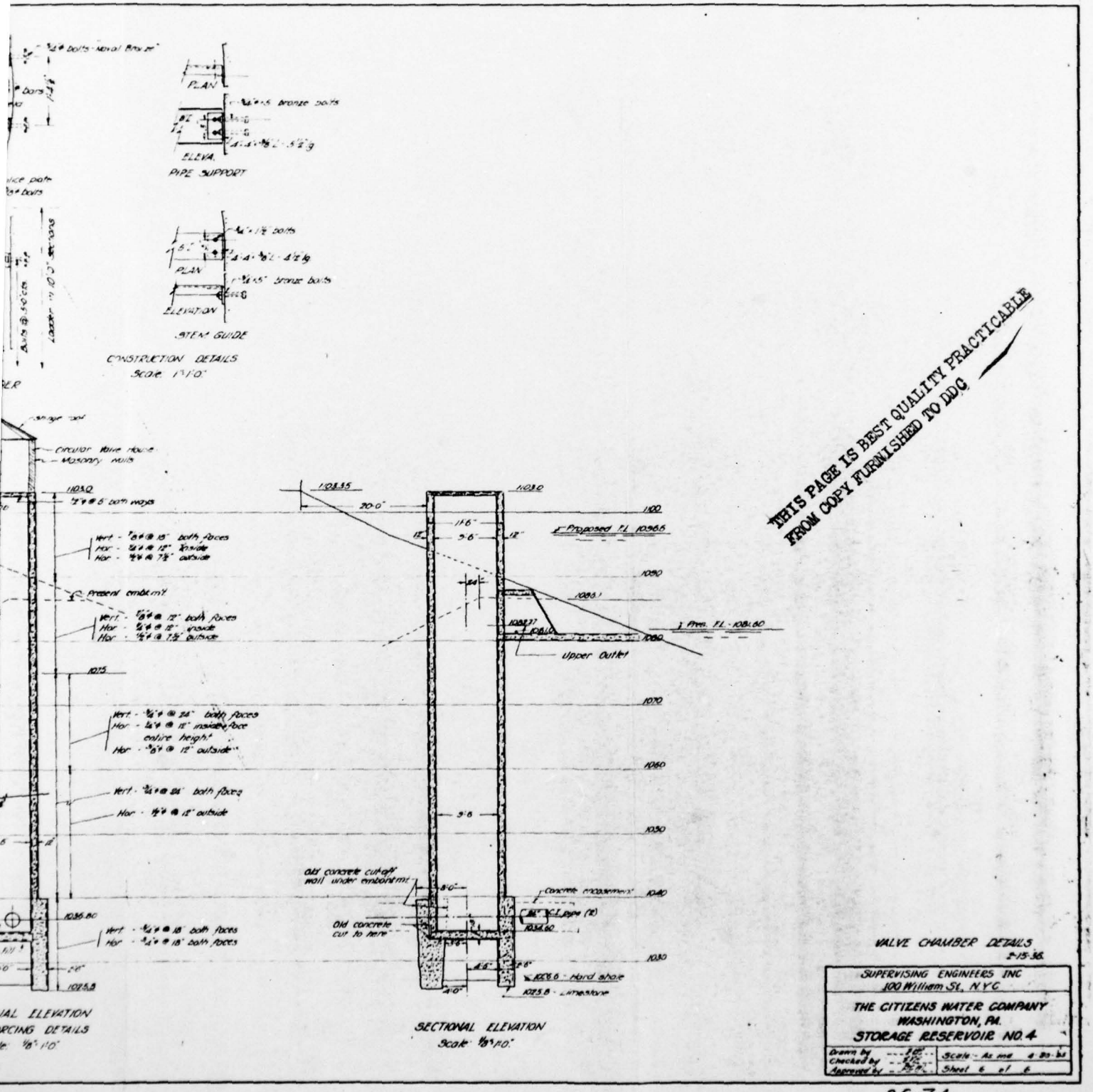


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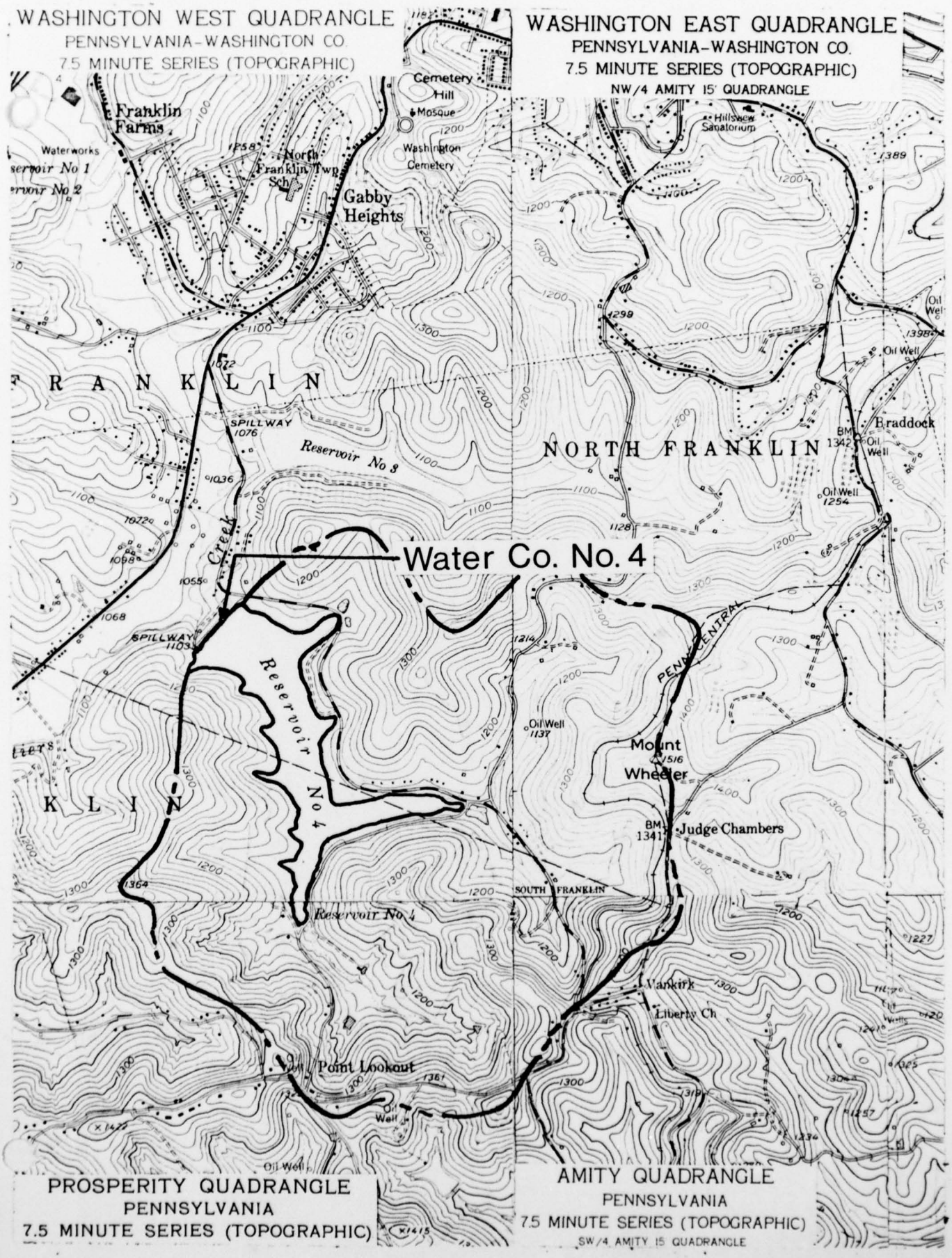
FIGURE 6

APPENDIX G

REGIONAL VICINITY MAP


WASHINGTON WEST QUADRANGLE
PENNSYLVANIA-WASHINGTON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
WASHINGTON EAST QUADRANGLE
PENNSYLVANIA-WASHINGTON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 AMITY 15' QUADRANGLE
Water Co. No. 4
Reservoir No 3
Reservoir No 4
Reservoir No 4
Franklin Farms
Cemetery Hill
Mosque
Washington Cemetery
North Franklin Twp Sch
Gabby Heights
Waterworks
Hillside Sanatorium
Braddock
Oil Well
Mount Wheeler
Judge Chambers
SOUTH FRANKLIN
Point Lookout
Liberty Ch
SPILLWAY
PROSPERITY QUADRANGLE
PENNSYLVANIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
AMITY QUADRANGLE
PENNSYLVANIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 AMITY 15' QUADRANGLE